Operating Instructions

Diesel engine
12V 2000 C66
16V 2000 C66

MS150094/01E

Power. Passion. Partnership.

Printed in Germany

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

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1 Safety

1.1 General conditions

General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention and environmental protection must be observed. This state-of-the-art engine has been designed to meet all applicable laws and regulations. The engine may nevertheless present a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the Safety Instructions

Correct use

The engine is intended solely for use in accordance with contractual agreements and the purpose envisaged for it on delivery. Any other use is considered improper use. The engine manufacturer accepts no liability whatsoever for resultant damage or injury in such case. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the maintenance specifications.

Modifications or conversions

Unauthorized modifications to the engine represent a safety risk.

MTU will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

Spare parts

Only genuine MTU spare parts must be used to replace components or assemblies. MTU accepts no liability whatsoever for damage or injury resulting from the use of other spare parts and the warranty shall be voided in such case.

Reworking components

Repair or engine overhaul must be carried out in workshops authorized by MTU.

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1.2 Personnel and organizational requirements

Personnel requirements

All work on the engine shall be carried out by trained and qualified personnel only.

The specified legal minimum age must be observed.

The operator must specify the responsibilities of the operating, maintenance and repair personnel.

Organizational measures

This publication must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep it at hand at the operating site of the engine so that it is available to operating, maintenance, repair and transport personnel at all times.

Use the manual as a basis for instructing personnel on engine operation and repair with an emphasis on explaining safety-relevant instructions.

This is particularly important in the case of personnel who only occasionally perform work on or around the engine. This personnel must be instructed repeatedly.

For the identification and layout of the spare parts during maintenance or repair work, take photos or use the spare parts catalog.

Working clothes and protective equipment

Wear proper protective clothing for all work.

Use the necessary protective equipment for the given work to be done.

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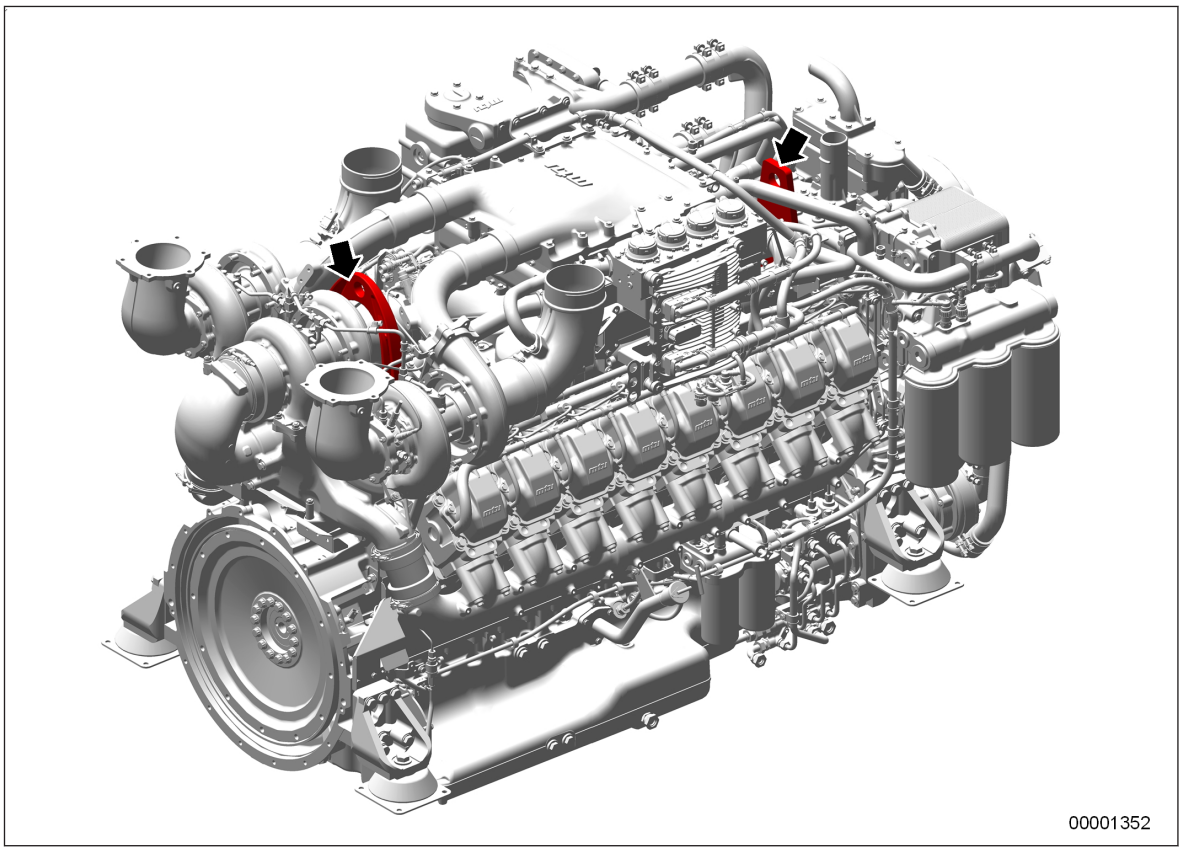
1.3 Transport

Transport

Also valid for 12V engines



Only use the lifting eyes provided to lift the engine.

Only use transport and lifting devices approved by MTU.

Take the engine's center of gravity into account.

The engine must only be transported in installation position, max. permissible diagonal pull 10°.

If the engine is supplied with special aluminum foil packing, lift the engine at the lifting eyes of the bearing pedestal or use a means of transportation which is appropriate for the given weight (forklift truck).

Install the crankshaft locking device and the locking screws for the engine mounts prior to engine transportation.

Secure the engine against tilting during transport. In particular when going down inclines or ramps, the engine must be secured against moving and tilting.

Setting the engine down after transport

Only set down engine on a firm, level surface.

Make sure that the consistency and load-bearing capacity of the ground or support surface is adequate.

Never set an engine down on the oil pan unless expressively authorized to do so by MTU on a case-to-case basis .

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1.4 Safety regulations for maintenance and repair work

Safety regulations for maintenance and repair work

Have maintenance and repair work carried out by qualified and authorized personnel only.

Allow the engine to cool down before starting maintenance work (risk of explosion of oil vapors).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened.

Take special care when removing ventilation or plug screws from the engine. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take special care when draining hot fluids ⇒ Risk of injury.

When changing the engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.

Allow the engine / system to cool down before starting to work.

Observe the maintenance and repair instructions.

Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.

Secure the engine against accidental starting.

Disconnect the battery when electrical starters are fitted.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the assembly or system.

Use only proper, calibrated tools. Observe the specified tightening torques during assembly/disassembly.

Carry out work only on assembles and/or units which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomeric seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal ⇒ Risk of burning.

When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.

Observe special cleanness when conducting maintenance and repair work on the assembly or system. After completion of maintenance and repair work, make sure that no loose objects are in/on the assembly or system.

Before barring the engine, make sure that nobody is standing in the danger zone. Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the engine.

The following additional instructions apply to starters with beryllium copper pinion:

- Breathing protection of filter class P2 must be applied during maintenance work to avoid health hazards caused by the beryllium-containing pinion. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device as an additional measure.

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Welding work

Never carry out welding work on the assembly, system, or engine-mounted units. Cover the engine when welding in its vicinity.

Do not use the assembly or system as ground terminal.

Do not route the welding lead over or near the wiring harnesses of MTU systems. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the engine beforehand.

Hydraulic installation and removal

Check the function and safe operating condition of tools and fixtures to be used. Use only the specified devices for hydraulic removal/installation procedures.

Observe the max. permissible push-on pressure specified for the equipment.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:
- Vent the hydraulic installation/removal tool, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the tool with the piston retracted.
- For hydraulic removal, screw on the tool with the piston extended.

For a hydraulic installation/removal tool with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

Working on electrical/electronic assemblies

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable binders to secure cables.

Always use connector pliers to tighten connectors.

Subject the device or system to a function check on completion of all repair work.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. particularly protected against moisture and impact and wrapped in antistatic foil if necessary.

Working with laser equipment

When working with laser equipment, always wear special laser-protection goggles ⇒ Heavily focused radiation.

Laser equipment must be fitted with the protective devices necessary for safe operation according to type and application.

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For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

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1.5 Auxiliary materials, fluids and lubricants, fire prevention and environmental protection

Fire prevention

Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires – therefore always keep the engine in a clean condition. Do not leave cloths soaked with fluids and lubricants lying on or near the assembly or unit. Do not store inflammable material near the assembly or unit.

Do not weld pipes and components carrying oil or fuel! Before welding, clean with a nonflammable fluid.

When starting the engine with an external power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the external power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable firefighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

Noise

Noise can lead to an increased risk of accident if acoustic signals, warning shouts or noises indicating danger are drowned.

Wear ear protectors in work areas with a sound pressure level in excess of 85 dB (A).

Environmental protection and disposal

Modification or removal of mechanical or electronic components or the installation of additional components as well as the execution of calibration processes that might affect the emission characteristics of the engine are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by MTU or equivalent components. Noncompliance with these guidelines might represent a violation of the Clean Air Act and involves the termination of the operating license by the emission authorities. MTU does not accept any liability for violations of the emission regulations. MTU will provide assistance and advice if emission-relevant components are intended to be modified. The MTU Maintenance Schedules ensure the reliability and performance of MTU engines and must be complied with over the entire life cycle of the engine.

Use only fuel of prescribed quality to comply with emission limit values.

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Within the EU, batteries can be returned free of charge to MTU FN / MTU Onsite Energy where they are subjected to proper recycling procedures.

Auxiliary materials, fluids and lubricants

Use only fluids and lubricants that have been tested and approved by MTU.

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Before using them, make sure you have the latest version. The latest version is also available at: http://www.mtu-online.com/mtu/mtu-valuecare/mtu-valueservice-Technische-Dokumentation.

Keep fluids and lubricants in suitable, properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions that apply to the product. Take special care when using hot, chilled or caustic materials. When using flammable materials, avoid all sparks and do not smoke.

Used oil

Used oil contains harmful combustion residues.

Rub barrier cream into hands.

Wash hands after contact with used oil.

TIM-ID: 0000000880 - 016

Lead

- When working with lead or lead-containing compounds, avoid direct contact to the skin and do not inhale lead vapors.
- Adopt suitable measures to avoid the formation of lead dust.
- Switch on extraction system.
- Wash hands after contact with lead or lead-containing substances.

Compressed air

Observe special safety precautions when working with compressed air:

- Pay special attention to the pressure level in the compressed air network and pressure vessel.
- Assemblies and equipment to be connected must either be designed for this pressure, or, if the permitted pressure for the connecting elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection.
- Hose couplings and connections must be securely attached.
- Wear goggles when blowing off components or blowing away chips.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line, or before equipment or tool is to be replaced.
- Unauthorized use of compressed air, e.g. forcing flammable liquids (danger class AI, AII and B) out of containers, results in a risk of explosion.
- Forcing compressed air into thin-walled containers (e.g. containers made of tin, plastic and glass) for drying purposes or to check for leaks, results in a risk of bursting.
- Carry out leak test in accordance with the specifications.

Paints and lacquers

- When carrying out painting work outside the spray stands provided with fume extraction systems, ensure that the area is well ventilated. Make sure that neighboring work areas are not impaired.
- No open flames.
- No smoking.
- Observe fire prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.

Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and protective goggles / safety mask.
- Make sure that working area is well ventilated.
- Avoid all knocks and jars to the containers, fixtures or workpieces.

Acids and alkaline solutions

- When working with acids and alkaline solutions, wear protective goggles or face mask, gloves and protective clothing.
- If such solutions are spilled onto clothing, remove the affected clothing immediately.
- Rinse injured parts of the body thoroughly with clean water.
- Rinse eyes immediately with eyedrops or clean tap water.

TIM-ID: 0000000880 - 016

1.6 Conventions for safety instructions in the text

DANGER	In the event of immediate danger. **Consequences: Death or serious injury** • Remedial action
WARNING	In the event of potentially dangerous situations. **Consequences: Death or serious injury** • Remedial action
CAUTION	In the event of dangerous situations. **Consequences: Minor injury or material damage** • Remedial action
NOTICE	In the event of a situation involving potentially adverse effects on the product. **Consequences: Material damage.** • Remedial action • Additional product information

Note: This manual contains highlighted safety warnings in accordance with the US ANSI Z535 standard which begin with one of the signal words listed above depending on the severity of the hazard.

Safety instructions

1. Read and familiarize yourself with all safety notices before starting up or repairing the product.
2. Pass on all safety instructions to your operating, maintenance, repair and transport personnel.

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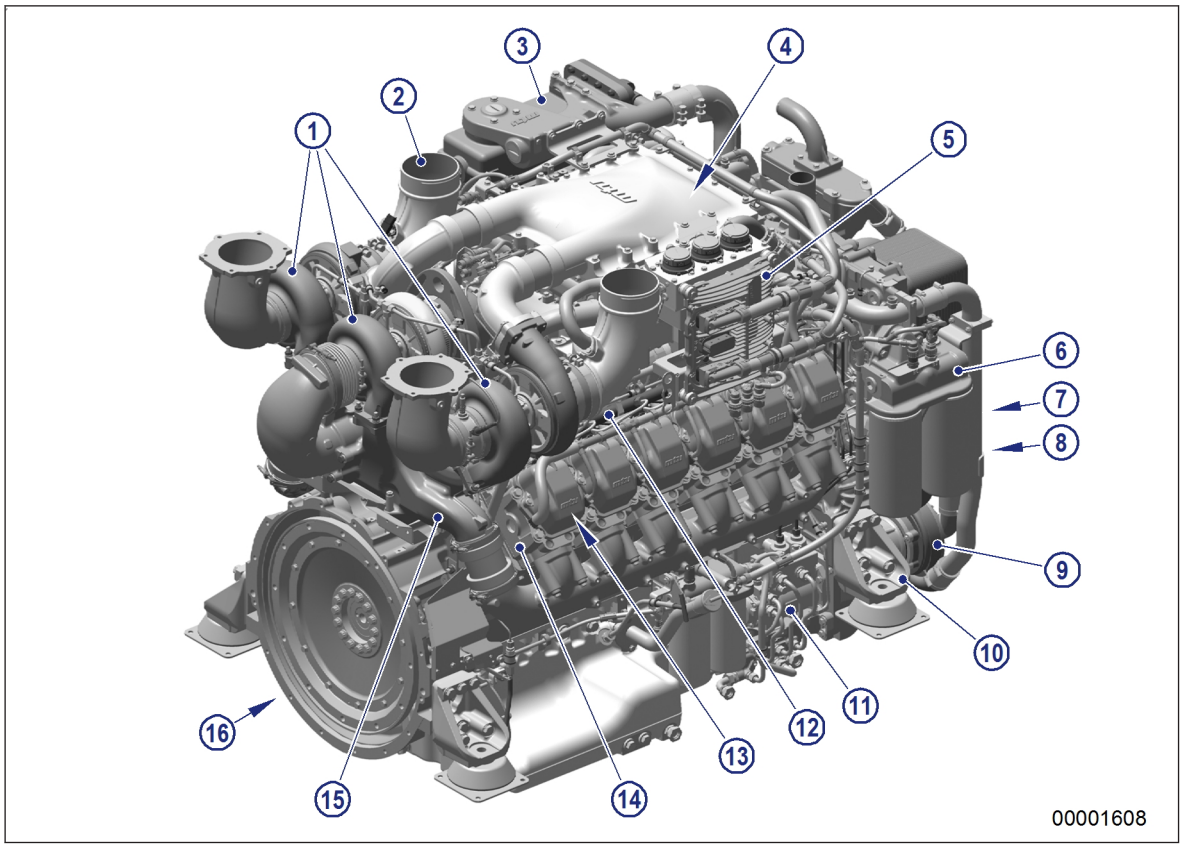
2 Product Summary

2.1 Engine – Overview

12/16 V 2000 C66/S96

This overview also applies to 16 V 2000 C66 and 16 V 2000 S96 engines.



1 Exhaust turbocharger
2 Air intake/air supply
3 EGR cooler
4 Intercooler
5 Monitoring, control and regulation equipment, general electr. equipment
6 Lube oil system / lube oil circuit
7 Power supply
8 Cooling air system
9 Coolant system
10 Mounting / support
11 Fuel system (low pressure)
12 Fuel system (high pressure)
13 Valve gear
14 Cylinder head
15 Exhaust system
16 PTO systems, driving end and free end (coupling)
17 Starting equipment

Engine model designation

Key to the engine model designation	
12/16	Number of cylinders
V	Cylinder arrangement: V engine
2000	Series

TIM-ID: 0000023527 - 002

Key to the engine model designation	
C/S	Application: C, charge-air cooling in internal circuit, with piston cooling Application S: Exhaust turbocharging with supercharger
6/9	Application segment (0, 1, 2,...,9)
6	Design index (0, 1, 2,...,9)

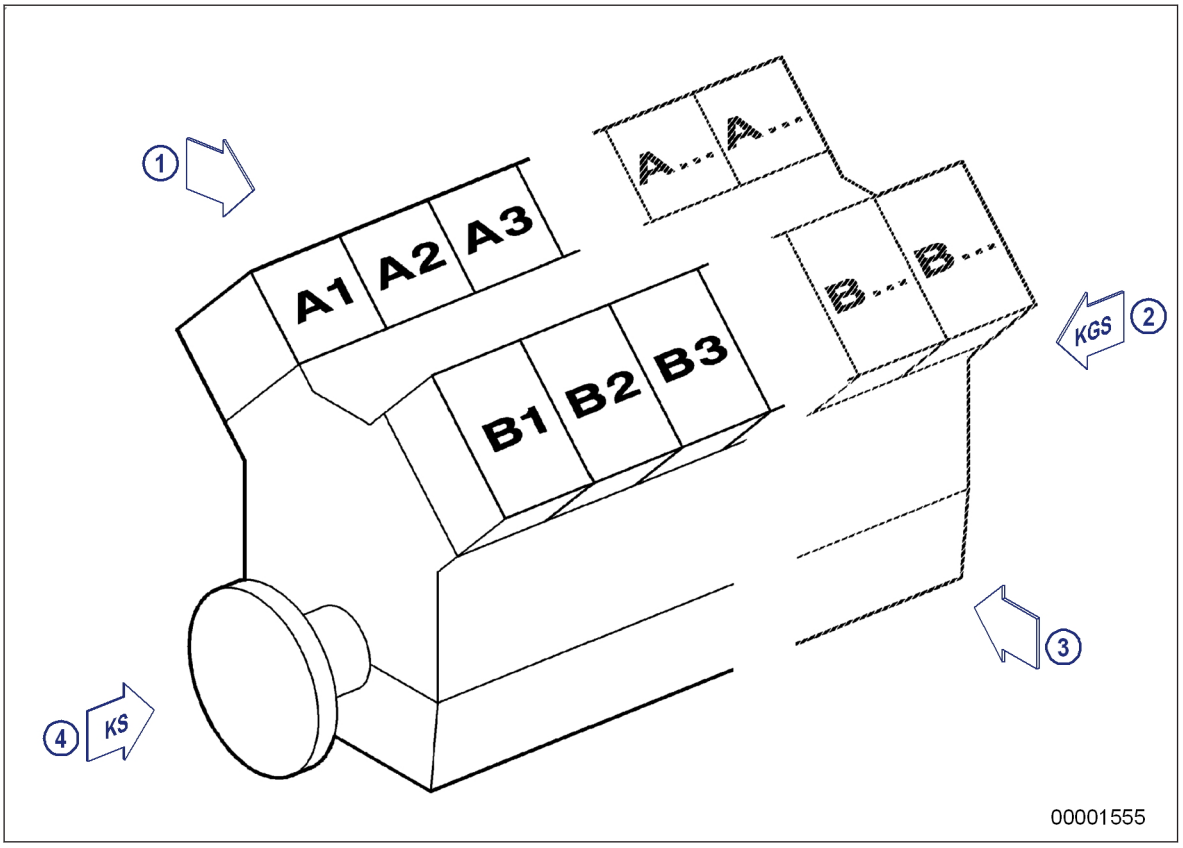
TIM-ID: 0000023527 - 002

2.2 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS).

The cylinders of the left engine side are designated "A" and those of the right side "B" (as per DIN ISO 1204). The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end.

Other components are numbered in the same way, i.e. starting with No. 1 on driving end.



1 Left engine side
2 KGS = Free end
3 Right engine side
4 KS = Driving end

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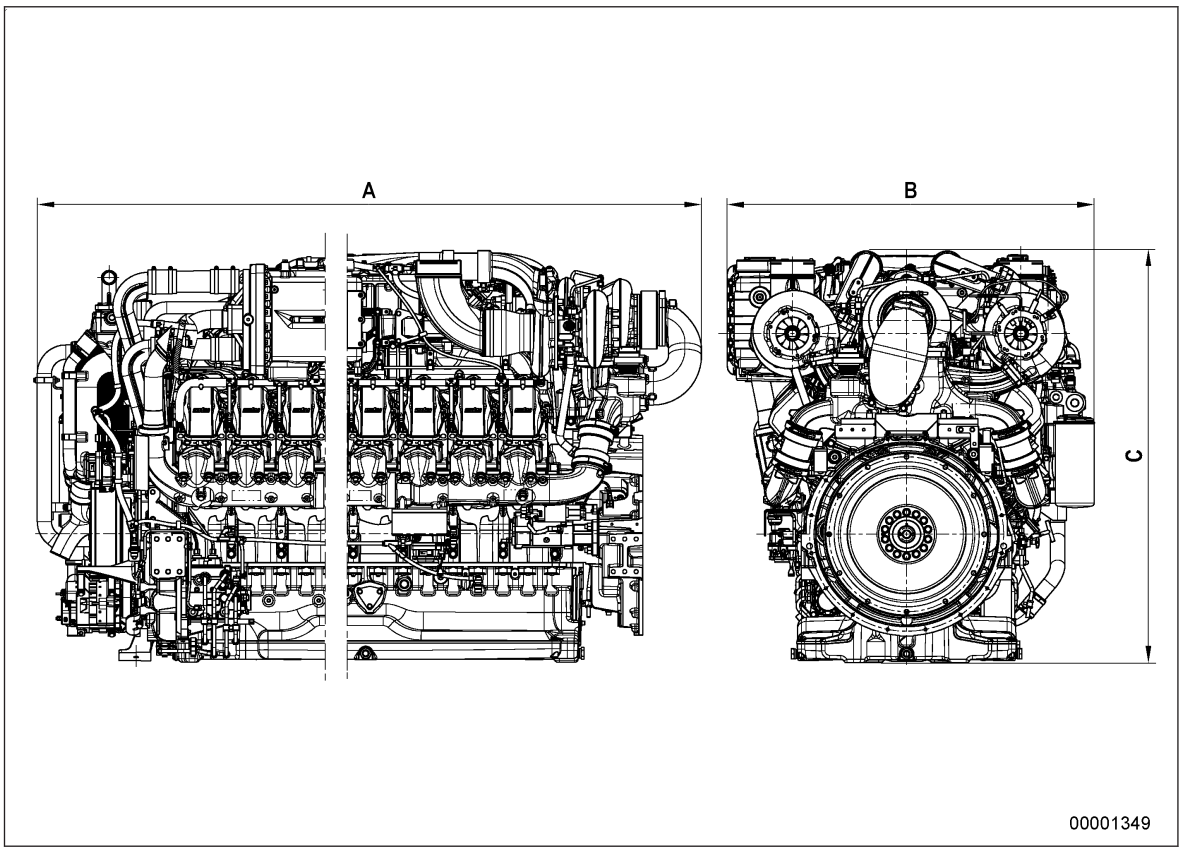
2.3 Engine – Main dimensions



Item	Engine model / Dimension	Engine model / Dimension
	12 V 2000 C66/S96	16 V 2000 C66/S96
Length (A)	approx. 2028 mm	approx. 2378 mm
Width (B)	approx. 1276.5 mm	approx. 1287 mm
Height (C)	approx. 1429 mm	approx. 1442 mm

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2.4 Firing order

Firing order for 12 / 16 V 2000 C66/S96 engines

Number of cylinders	Firing order
12 V	A1-B5-A5-B3-A3-B6-A6-B2-A2-B4-A4-B1
16 V	A1-B5-A3-A5-B2-B8-A2-A8-B3-A7-B4-B6-A4-A6-B1-B7

TIM-ID: 0000023721 - 001

2.5 Technical Data

2.5.1 12/16V 2000 C66 engine data

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated, without change (e.g. of power setting)
N Not yet defined value
- Not applicable
X Applicable

Engine model			12V2000 C66	16V2000 C66
Application group			5B	5B
Intake air temperature		°C	25	25
Charge-air coolant temperature		°C	45	45
Barometric pressure		mbar	1000	1000
Site altitude above sea level		m	100	100

POWER-RELATED DATA (power ratings are net brake power as per ISO 3046)

Number of cylinders			12	16
Rated engine speed	A	rpm	2100	2100
Effective power (w/o fan) (Fuel stop power ISO 3046)	A	kW	783	970

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12	16
Intake depression (new filter)	A	mbar	15	15
Intake depression, max.	L	mbar	50	50
Exhaust overpressure	A	mbar	30	30
Exhaust gas overpressure, max.	L	mbar	100	100
Fuel temperature at engine inlet connection	R	°C	37	37
Fuel temperature at engine inlet connection, max (w/o power reduction)	L	°C	65	65

CONSUMPTION

Number of cylinders			12	16
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.35	0.35

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MODEL RELATED DATA (basic design)

Number of cylinders			12	16
Number of cylinders			12	16
Cylinder arrangement: V angle		Degrees (°)	90	90
Bore		mm	135	135
Stroke		mm	156	156
Cylinder displacement		Liters	2.233	2.233
Total displacement		Liters	26.80	35.73
Inlet valves per cylinder			2	2
Exhaust valves per cylinder			2	2

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			12	16
Charge-air pressure before cylinder	R	bar abs	3.95	3.80
Exhaust temperature after turbocharger	R	°C	390	390

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100
Coolant temperature after engine, warning	R	°C	101	101
Coolant temperature after engine, shutdown	L	°C	104	104
Coolant antifreeze content, max.	L	%	50	50
Coolant pump: inlet pressure, max.	L	bar	1.3	1.3
Thermostat: Starts to open	R	°C	79	79
Thermostat: Fully open	R	°C	92	92

COOLING SYSTEM (LT circuit)

Number of cylinders			12	16
Coolant antifreeze content, max.	L	%	50	50
Charge-air temperature after charge-air cooler, max.	L	°C	95	95
Thermostat: Starts to open	R	°C	38	38
Thermostat: Fully open	R	°C	51	51

LUBE OIL SYSTEM

Number of cylinders			12	16
Lube oil operating temperature before engine, from	R	°C	80	80
Lube oil operating temperature before engine, to	R	°C	103	103
Lube oil temperature before engine, alarm	R	°C	103	103
Lube oil temperature before engine, shutdown	L	°C	106	106
Lube oil operating pressure before engine, warning	R	bar	6.0	6.0
Lube oil operating pressure before engine, shutdown	L	bar	5.5	5.5

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FUEL SYSTEM

Number of cylinders			12	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.5	-0.5
Fuel pressure at engine inlet connection, min. (when engine is running),	L	bar	-0.5	-0.5
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0.5	0.5

GENERAL OPERATING DATA

Number of cylinders			12	16
Coolant preheating: preheating temperature (min.)	R	°C	32	32

INCLINATIONS, STANDARD OIL SYSTEM (reference: waterline)

Number of cylinders			12	16
Longitudinal inclination, continuous max. driving end down (Option: max. operating inclinations)	L	Degrees (°)	15	15
Longitudinal inclination, continuous max. driving end up (Option: max. operating inclinations)	L	Degrees (°)	15	15
Transverse inclination, continuous max. (option: max. operating inclinations)	L	Degrees (°)	15	15

CAPACITIES

Number of cylinders			12	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	63	70
Charge-air coolant, engine side	R	Liters	25	28
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	103	127
Oil pan capacity at dipstick mark “min.” (standard oil system) (Option: max. operating inclinations)	L	Liters	79	97
Oil pan capacity at dipstick mark “max.” (standard oil system) (Option: max. operating inclinations)	L	Liters	86	106

ACOUSTICS

Number of cylinders			12	16
Exhaust noise, unsilenced - BL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	106	107
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798+3 db(A) tolerance)	R	dB(A)	119	120
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound power level Lp, 1 m distance, ISO 6798, +2dB(A) tolerance)	R	dB(A)	102	103
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798+2dB(A) tolerance)	R	dB(A)	120	121

TIM-ID: 0000024846 - 002

3 Operation

3.1 Putting the engine into operation after extended out-of-service periods (>3 months)

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Putting into operation after long out-of-service periods (>3 months)

Item	Action
Engine	Depreserve (→ MTU Fluids and Lubricants Specifications A001061/..).
Lube oil system	Check engine oil level (→ Page 69).
Fuel system	Connect appropriate equipment to fuel supply line to fill the system.
Fuel system	Vent (→ Page 56).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 80). Change charge-air coolant (→ Page 89).
Coolant circuit	Check engine coolant level (→ Page 79); Check charge-air coolant level (→ Page 88).
Coolant circuit	Preheat engine coolant with coolant preheating unit (if fitted).
Engine governor	Check plug-in connections (→ Page 108).
Engine control system	Switch on.

TIM-ID: 0000010073 - 002

3.2 Putting the engine into operation after scheduled out-of-service-period

Preconditions

☑ Engine is stopped and starting disabled.

Putting into operation

Item	Action
Lube oil system	Check engine oil level (→ Page 69).
Coolant circuit	Check engine coolant level (→ Page 79), check charge-air coolant level (→ Page 88).
Coolant circuit	Preheat engine coolant with coolant preheating unit, if fitted.
Fuel prefilter (if fitted)	Drain water and contaminants, see manufacturer's documentation.
Engine control system	Switch on.

TIM-ID: 0000010642 - 002

3.3 Tasks after extended out-of-service periods (>3 weeks)

Tasks after extended out-of-service periods (>3 weeks)

Note: Operate fuel treatment system for at least 5 minutes.

1. Start up fuel treatment system (→ Page 26).
2. Shut down fuel treatment system (→ Page 34).

TIM-ID: 0000007730 - 005

3.4 Checks prior to start-up

Checks prior to start-up

1. Check tank and the entire pipework for cleanness. If microorganisms are detected:
   a) Clean affected components.
   b) Disinfect affected components with biocides (→ MTU Fluids and Lubricants Specifications A001061/..).
2. Close drain valves on housing.
3. Open all supply and discharge valves.
4. Switch on fuel treatment system (→ Page 29).
5. Check direction of rotation of pump.
6. Vent bypass and fuel lines of the system.
   a) Open ball valve for pressure tank.
   b) Open ball valve for overflow tank.
   c) Close ball valve at the inlet to the fuel treatment system.

Result: Bypass line is vented via the overflow tank.

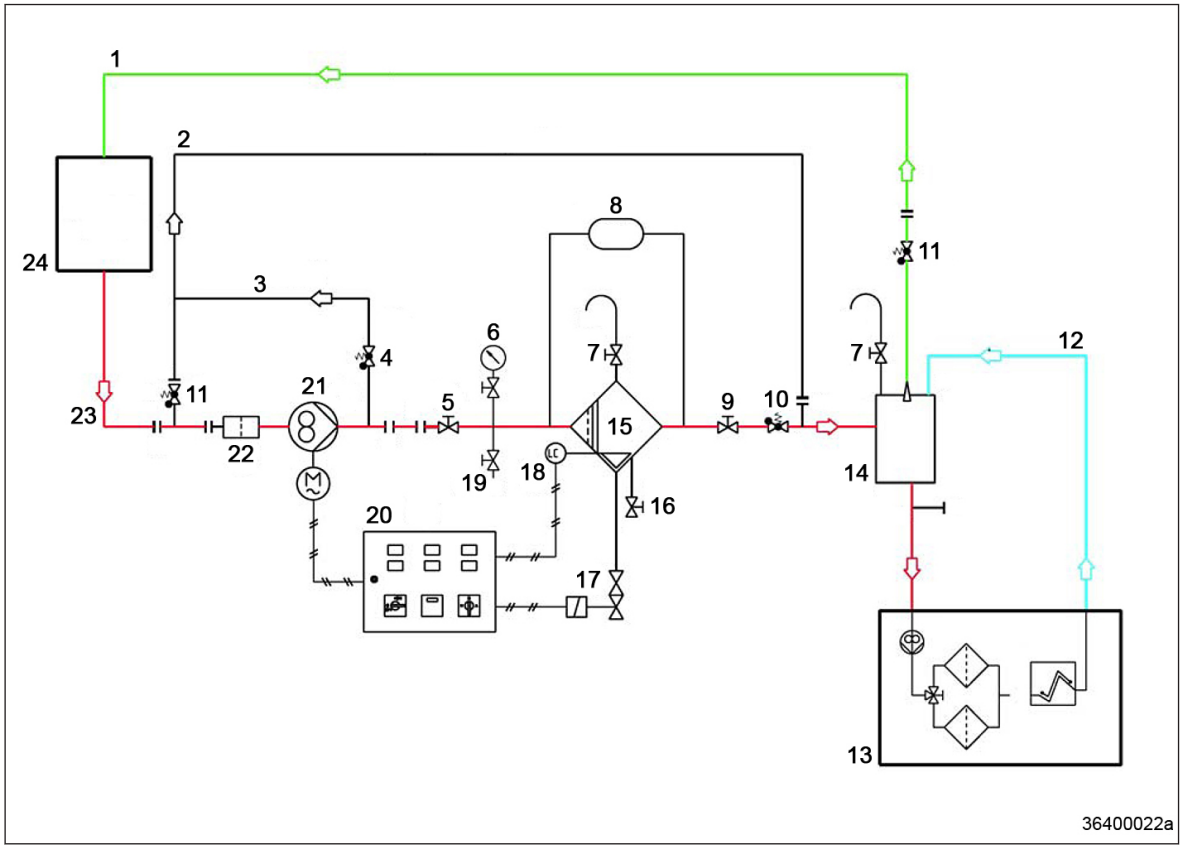
   d) Open ball valve at the inlet to the fuel treatment system.
7. Check the fuel treatment system for leaks.

Result: The fuel treatment system is ready for operation.

TIM-ID: 0000007736 - 005

3.5 Fuel treatment system – Putting into operation

Fuel treatment system – Overview



1. Switch on fuel treatment system (→ Page 29).
2. Check the differential pressure at differential pressure gauge (8). Differential pressure in a new system: 0.1 bar to 0.3 bar.

Result: If no differential pressure is measured, the coalescer filter element is probably being bypassed.
1. Remove coalescer filter element (→ Page 103).
2. Check sealing faces on coalescer filter element and in the pressure tank.

Initial operation: HAT

1. Replace fuel filter on engine (→ Page 58).

Note: Determine the suction pressure upstream of the engine-mounted fuel delivery pump.
2. Install a pressure gauge in the fuel supply line from the shipyard-side fuel system to the engine.
3. Switch on fuel treatment system and operate it for some minutes (→ Page 29).

Result: Fuel is sucked from the tank, dirt particles and water are filtered and separated, then the fuel is delivered via the overflow tank back to the tank. Water which has settled in the tank is separated.
4. Start engine (→ Page 28).
5. Run engine at idling speed.
6. Check suction pressure (see technical data of the engine) at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:
7. Increase engine speed to 1000 rpm and monitor suction pressure.
8. Check suction pressure at the engine-mounted fuel delivery pump.

Result: If the values are within the limits specified by the manufacturer, the system is ready to start filter replacement simulation with the engine running as part of the Harbor Acceptance Tests.

TIM-ID: 0000007738 - 005

Simulation of filter replacement with the engine running: HAT

1. Switch on fuel treatment system (→ Page 29).
2. Start engine (→ Page 28).
3. Run engine at idling speed.
4. Close ball cock (5) at the inlet to the fuel treatment system.

Result: The pressure upstream of the fuel treatment system increases until the overflow valve at the pump unit opens and fuel flows through bypass (3) and bypass (2).

5. Open ball cock (19).

Result: Fuel emerges. If no fuel emerges:
- Open ball cock (5) at the inlet to the fuel treatment system.
- No function of bypasses (2) and (3); carry out functional test of bypasses (2) and (3).

6. Check suction pressure (see technical data of the engine) at the fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:

7. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If all engine operating values are within the specified limits, open ball cock (5) at the inlet to the fuel treatment4 system.

Simulation of power failure (emergency): HAT

1. Switch on fuel treatment system (→ Page 29).
2. Start engine (→ Page 28).
3. Run engine at idling speed.
4. Switch off pump (21) on switch cabinet.

Result: The engine-mounted fuel delivery pump sucks fuel via bypass (2) directly from the tank.

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

6. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

Simulation of power failure (emergency): SAT

1. Switch on fuel treatment system (→ Page 29).
2. Start engine (→ Page 28).
3. Run engine at idling speed.
4. Switch off pump (21) on switch cabinet.

Result: The engine-mounted fuel delivery pump sucks fuel via bypass (2) directly from the tank.

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory:

6. Operate engine at full load and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

TIM-ID: 0000007738 - 005

3.6 Starting the engine

Preconditions

☑ Engine is not connected to load.

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Start engine (For required operations, refer to the documentation of the vehicle/plant manufacturer).

TIM-ID: 0000010107 - 004

3.7 Fuel treatment system – Switching on

Preconditions

☑ The on-board power supply is switched on.

CAUTION

Damage to engine/plant.
Major material damage!
- Before switching on, ensure that the engine/plant is ready for operation.
- Before switching on, ensure that all housings are closed.
- Before switching on, ensure that no work is in progress anywhere on the entire system.

Switching on fuel treatment system

1. Carry out checks prior to start-up (→ Page 25).
2. Switch on master switch on switch cabinet.

Result: Signal lamp “Control voltage present” lights up.

3. Switch on switch for pump.

Result: Signal lamp “Pump running” lights up.

TIM-ID: 0000007731 - 005

3.8 Operational checks

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Operational checks

Item	Action
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 69).
Engine operation	Check engine visually for leaks and general condition; Check engine for abnormal running noises, exhaust color and vibrations.
Air filter	Check service indicator at air filter (if fitted), see manufacturer's documentation.
Exhaust system	Check exhaust color (→ Page 38).
Fuel prefilter (if fitted)	Check reading at differential pressure gauge of fuel prefilter, see manufacturer's documentation.
Intercooler	Check condensate drain(s) for water discharge and obstruction.
Engine coolant pump	Check relief bore (→ Page 84).
Charge-air coolant pump	Check relief bore (→ Page 93).

TIM-ID: 0000025277 - 002

3.9 Stopping the engine

Preconditions

☑ Engine is not connected to load.

CAUTION

Stopping the engine when it is running at full load causes extreme stress to the engine.
Risk of overheating, damage to components!

- Before stopping the engine, operate it at idle speed until operating temperatures decrease and stable values are indicated.

Preparation

Item	Action
Engine	Allow the engine to cool down by running idle for approx. 5 minutes.

Stop engine (For required operations, refer to the documentation of the vehicle/plant manufacturer).

TIM-ID: 0000010138 - 004

3.10 Emergency stop

CAUTION

An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to components!
- Initiate emergency stop only in emergency situations.

Emergency stop

Item	Action
Emergency stop pushbutton	Press EMERGENCY STOP button. • Engine is stopped by disconnecting the power supply to the ECU; • Emergency air shutoff flaps close (if provided); • signalization (e.g. by horn, beacon) is activated.

After emergency stop

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Press pushbutton for alarm acknowledgment. • Audible and visual signalization stops.
Engine	Manually open emergency air shutoff flaps (if provided). • Engine is ready for starting.

TIM-ID: 0000002307 - 002

3.11 After stopping the engine

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Note: If freezing temperatures are to be expected: Coolant pressure sensors installed in vertical position may be damaged if the coolant does not contain antifreeze additive.

After stopping the engine

Item	Action
Coolant circuit	Drain engine coolant (→ Page 81); Drain charge-air coolant (→ Page 92) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not kept at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40 °C.
Engine control system	Switch off.
Air intake and exhaust system	If the engine is to remain out of service for more than 1 week, seal the engine's air and exhaust sides. If the engine is to remain out of service for more than 1 month, carry out preservation (→ MTU Fluids and Lubricants Specifications A001061/..).

TIM-ID: 0000002709 - 005

3.12 Fuel treatment system – Shutdown

Shutting down fuel treatment system

1. Press the illuminated pushbutton "Water drain" on the switch cabinet until water discharge from the outlet stops.
2. Switch off fuel treatment system.
3. Close ball valve at the inlet to the fuel treatment system.
4. Close ball valve at the outlet of the fuel treatment system.
5. Open drain valve until pressure has escaped from fuel treatment system.

TIM-ID: 0000007732 - 005

3.13 Plant cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ Operating voltage is not present.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Steam jet cleaner	-	1
Cleaner (Hakupur 312)	30390	1

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Water jet.
Risk of injury and scalding!
- Do not direct water jet at persons.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Excessive reaction time of cleaning agents on components.
Damage to component!
- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

NOTICE

Dry with compressed air.
Damage to component!
- Never aim compressed air directly at electronic components.

Plant cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
3. During external cleaning of the plant with water/steam-jet units, the pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar. A minimum distance between spray nozzle and plant of 1 m must be observed. The temperature of the cleaning medium must not exceed 80 °C.
4. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
5. Carry out external cleaning as follows:
   a) Seal all openings in a suitable fashion.
   b) Remove coarse dirt.
   c) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
   d) Use the high-pressure jet to remove the loosened dirt.

Note: Never aim compressed air directly at electronic components.

   e) Dry engine.

TIM-ID: 0000010171 - 024

4 Maintenance

4.1 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Task	Maintenance tasks	
W0500	Check engine oil level.	(→ Page 69)
W0501	Visually inspect engine for leaks and general condition.	(→ Page 30)
W0502	Check intercooler drain(s).	(→ Page 30)
W0503	Check signal ring position of service indicator on air filter.	(→ Page 30)
W0505	Check relief bores of water pump(s).	(→ Page 30)
W0506	Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 30)
W0507	Drain water and contaminants from fuel prefilter.	(→ Page 30)
W0508	Check reading on differential pressure gauge of fuel prefilter.	(→ Page 30)
W1001	Replace fuel filter or fuel filter element.	(→ Page 58)
W1003	Check drive belt condition and tension, replace if necessary.	(→ Page 94)
W1005	Replace air filter.	(→ Page 65)
W1006	Replace fuel injectors.	(→ Page 48)
W1008	Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 71)
W1009	Check layer thickness of the oil residue, clean out and replace filter sleeve, at each oil change, at the latest.	(→ Page 72)
W1178	Replace pressure pipe neck in cylinder head.	(→ Page 54)
W1207	Check valve clearance, adjust if necessary. Attention!First adjustment after 1,000operating hours!	(→ Page 44)
W1244	Check function of rod electrode.	(→ Page 101)
W1245	Check alarm function of differential pressure gauge.	(→ Page 100)
W1246	Check pump capacity.	(→ Page 102)
W1523	Check operation of flaps and actuators.	(→ Page 68)
W1525	Replace NOx sensor.	(→ Page 110)
W1526	Replace Lambda sensor.	(→ Page 110)
W1547	Replace oil mist separator.	(→ Page 43)
W1636	Reset drift correction parameters (CDC) and enter coding of injectors (IIG).	(→ Page 117)

Table 1: Maintenance task reference table [QL1]

TIM-ID: 0000022887 - 003

5 Troubleshooting

5.1 Fuel treatment system – Troubleshooting

Illuminated pushbutton “Water alarm” is lit.

Cause	Corrective action
When the maximum water level is reached, the water level electrode opens the water drain valve and water is discharged. If the opening period of the valve exceeds a preset limit (4 minutes), the pump will switch off and an alarm is initiated.	1. Press illuminated pushbutton “Water alarm” to acknowledge. 2. In addition to the automatic water drain function, water can also be drained manually. To do so, press the illuminated pushbutton “Water drain” to open the drain valve.

Signal lamp “Pump fault” is lit.

Cause	Corrective action
The drive motor is equipped with an overload protection. If the maximum permissible current consumption is exceeded, e.g. in case of a blockage or dry-running, the motor protection relay triggers and the pump is switched off.	▶ Reset motor protection relay.

Signal lamp “Warning filter” is lit.

Cause	Corrective action
The differential pressure exceeded 1.3 bar.	▶ Replace coalescer filter element (→ Page 103).

Illuminated pushbutton “Replace filter element” is lit.

Cause	Corrective action
The max. permissible differential pressure of 1.5 bar was exceeded. If the coalescer filter element is not replaced, pressure will increase further and the safety valve will open. Fuel will be led via the bypass directly into the overflow tank.	1. Replace coalescer filter element (→ Page 103). 2. Press illuminated pushbutton “Replace filter element” to acknowledge.

TIM-ID: 0000007734 - 006

5.2 Troubleshooting

Engine does not turn when starter is actuated

Component	Cause	Action
Battery	Low or faulty	Charge or replace (see manufacturer's documentation).
	Cable connections faulty	Check if cable connections are properly secured (see manufacturer's documentation).
Starter	Engine cabling or starter faulty	Check cable connections for secure seating ; contact Service.
Engine wiring	Faulty	Check (→ Page 109).
Engine governor	Plug-in connections possibly loose	Check plug-in connections (→ Page 108).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Cause	Action
Starter	Poor rotation by starter: Battery low or faulty	Charge or replace battery (see manufacturer's documentation).
Engine wiring	Faulty	Check (→ Page 108).
Fuel system	Air in fuel system, if fault occurs after filling the system.	Vent fuel system (→ Page 56).
Engine governor	Faulty	Contact Service.

Engine fires unevenly

Component	Cause	Action
Fuel injection equipment	Injector faulty	Replace (→ Page 48).
Engine wiring	Faulty	Check (→ Page 109).
Fuel system	Air in fuel system, if fault occurs after filling the system.	Vent fuel system (→ Page 56).
Engine governor	Faulty	Contact Service.

Engine does not reach rated speed

Component	Cause	Action
Fuel supply	Fuel prefilter (if fitted) clogged.	Clean filter element (see manufacturer's documentation).
	Fuel filter clogged	Replace (→ Page 58).
Air supply	Air filter clogged	Replace air filter (→ Page 65).
Fuel injection equipment	Injector faulty	Replace (→ Page 48).
Engine wiring	Faulty	Check (→ Page 109).
Engine	Overloaded	Contact Service.

TIM-ID: 0000025278 - 001

Engine speed not steady

Component	Cause	Action
Fuel injection equipment	Injector faulty	Replace (→ Page 48).
Speed sensor	Faulty	Contact Service.
Fuel system	Air in fuel system, if fault occurs after filling the system.	Vent fuel system (→ Page 56).
Engine governor	Faulty	Contact Service.

Charge-air temperature too high

Component	Cause	Action
Engine coolant	Engine coolant treatment incorrect	Check (MTU test kit).
Intercooler	Contaminated	Contact Service.
Engine room	Air-intake temperature too high	Check fan; check air inlet/outlet ducts.

Charge-air pressure too low

Component	Cause	Action
Air supply	Air filter clogged	Replace air filter (see manufacturer's documentation).
Intercooler	Contaminated	Contact Service.
Exhaust turbocharger	Faulty	Contact Service.

Coolant leaks at intercooler

Component	Cause	Action
Intercooler	Leaking, major coolant discharge	Contact Service.

Black exhaust gas

Component	Cause	Action
Air supply	Air filter clogged	Replace air filter (see manufacturer's documentation).
Fuel injection equipment	Injector faulty	Replace (→ Page 48).
Engine	Overloaded	Contact Service.

Blue exhaust gas

Component	Cause	Action
Engine oil	Too much oil in engine	Drain engine oil (→ Page 70).
	Oil mist fine separator of crankcase breather clogged	Replace (→ Page 43).
Exhaust turbocharger	Faulty	Contact Service.
Cylinder head		
Piston rings		
Cylinder liner		

TIM-ID: 0000025278 - 001

White exhaust gas

Component	Cause	Action
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system at fuel prefilter Drain fuel prefilter (→ Page 60).
Intercooler	Leaking	Contact Service.

TIM-ID: 0000025278 - 001

6 Task Description

6.1 Engine

6.1.1 Engine – Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Barring tool	F6783914	1
Ratchet	F30006212	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine – Barring manually

1. Fit ratchet with barring tool on barring tool connection at the vibration damper on engine free end.
2. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no resistance.

Result: If the resistance exceeds the normal compression resistance, contact Service.

TIM-ID: 0000002527 - 002

6.1.2 Engine – Barring with starting system

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine – Barring with starting system

1. Bar engine, preventing it from firing, see documentation of vehicle/plant manufacturer.
2. Do not actuate starter for more than 10 seconds.
3. Repeat this procedure after approx. 20 seconds if required.

TIM-ID: 0000010695 - 002

6.2 Crankcase Breather

6.2.1 Crankcase breather – Oil mist fine separator replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

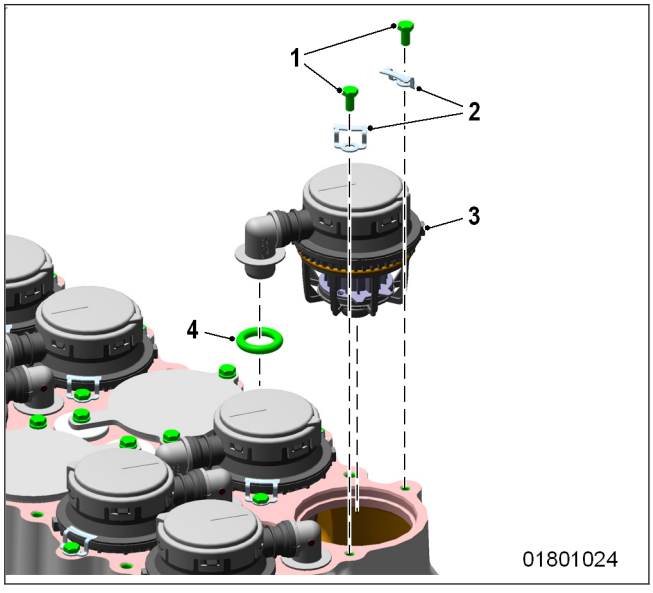
Designation / Use	Part No.	Qty.
Engine oil		
Oil mist fine separator	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing oil mist fine separator

1. Loosen screws (1) and remove together with retainer (2).
2. Replace oil mist fine separator (3).
3. Check O-ring (4), replace if necessary.
4. Replace further oil mist fine separators in the same way.



TIM-ID: 0000018590 - 005

6.3 Valve Drive

6.3.1 Valve clearance – Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40 °C.

☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y4345893	1
Barring device	F6783914	1
Ratchet	F30006212	1
Double-head box wrench	F30002800	1
Ring socket, 19 mm	F30038493	1
Torque wrench, 10-60 Nm	F30510423	1

WARNING

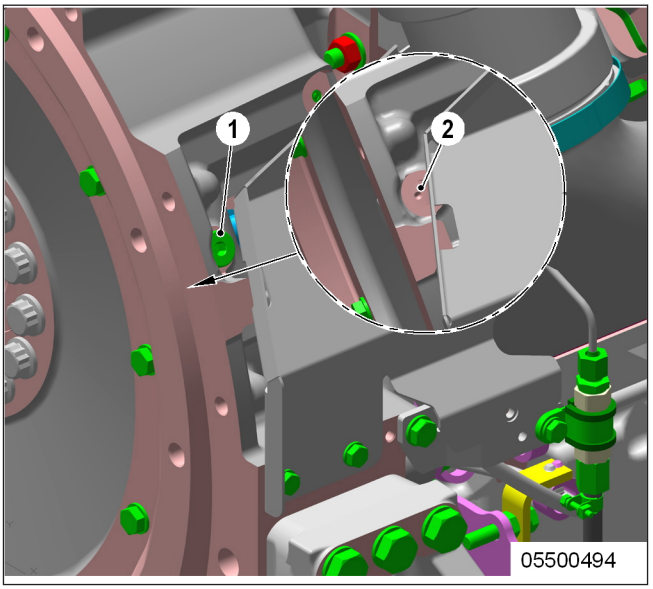
Valve gear is moving.
Risk of crushing!
- Keep hands clear of the danger zone when barring the engine.

Preparatory steps

▶ Remove cylinder head cover (→ Page 47).

Positioning A1 piston at TDC

1. Install barring device.
2. Release plug screw (1) and remove.
3. Using ratchet and barring device, rotate crankshaft in engine direction of rotation until the bore (2) on the flywheel is visible in the center of the exposed opening.



TIM-ID: 0000023895 - 003

Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
   - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
   - If the rocker arms are loaded on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
   - Inlet (E) = 0.3 mm;
   - Exhaust (A) = 0.4 mm.
3. Check all valve clearances at two crankshaft positions (firing TDC and overlap TDC) according to the table below.

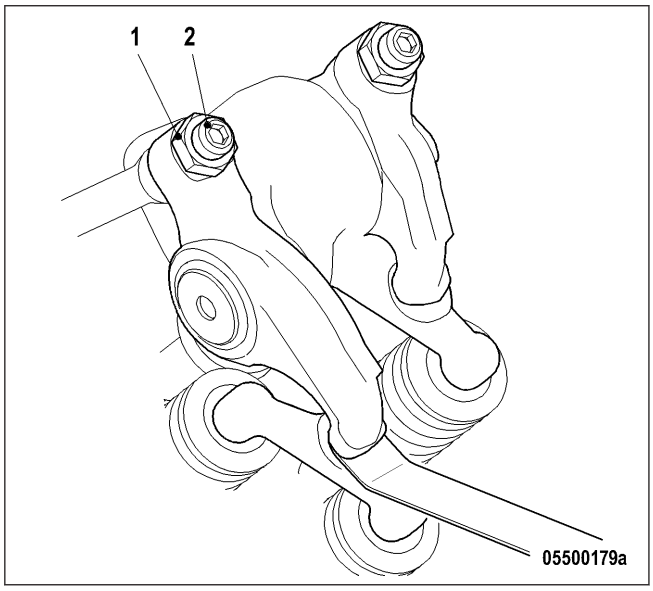
12 V 2000									
Position	Cylinder	1	2	3	4	5	6	7	8
Firing TDC in cylinder A1	Bank A	E A	E -	- A	E -	- A	- -		
	Bank B	E -	- -	- A	E -	E A	- A		
Overlap TDC in cylinder A1	Bank A	- -	- A	E -	- A	E -	E A		
	Bank B	- A	E A	E -	- A	- -	E -		
"E" = inlet valve clearance adjustment permitted, "A" = exhaust valve clearance adjustment permitted									

16 V 2000									
Position	Cylinder	1	2	3	4	5	6	7	8
Firing TDC in cylinder A1	Bank A	E A	- A	E A	E -	- A	E -	- -	- -
	Bank B	E -	- A	- -	- -	E A	E -	E A	- A
Overlap TDC in cylinder A1	Bank A	- -	E -	- -	- A	E -	- A	E A	E A
	Bank B	- A	E -	E A	E A	- -	- A	- -	E -
"E" = inlet valve clearance adjustment permitted, "A" = exhaust valve clearance adjustment permitted									

4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

Valve clearance adjustment

1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gauge between valve bridge and rocker arm.
3. Readjust adjusting screw (2) so that the feeler gauge just passes through the gap.



TIM-ID: 0000023895 - 003

4. Tighten locknut (1) with torque wrench to the specified tightening torque, holding the adjusting screw (2) with Allen key to prevent it from turning.

Name	Size	Type	Lubricant	Value/Standard
Locknut		Tightening torque		50 Nm +5 Nm

5. Insert feeler gauge between valve bridge and rocker arm to verify that the gauge just passes through the gap.

Result: If not, adjust valve clearance again.

Final steps

1. Insert plug screw and tighten.
2. Remove barring device.
3. Install cylinder head cover (→ Page 47).

TIM-ID: 0000023895 - 003

6.3.2 Cylinder head cover – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

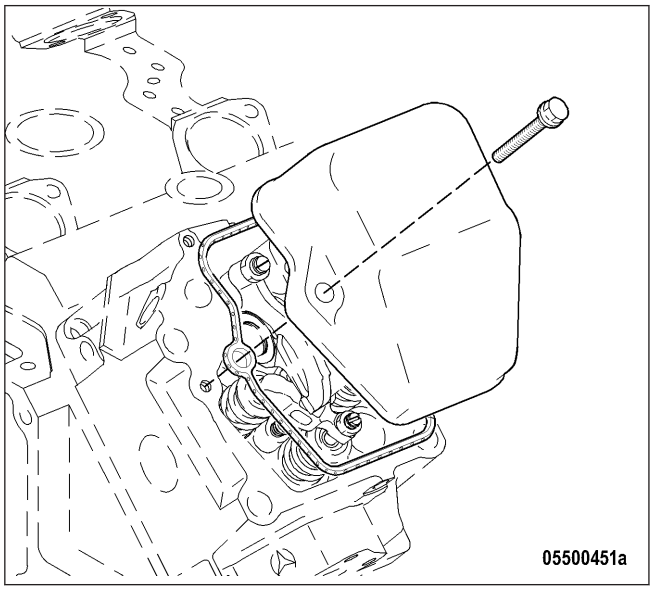
Designation / Use	Part No.	Qty.
Torque wrench, 8-40 Nm	F30043446	1
Ratchet	F30027340	1
Gasket	(→ Spare Parts Catalog)	

Preparatory steps

1. On cylinder head covers with crankcase breather: Loosen clamps.
2. Slide rubber sleeves onto the pipe.

Cylinder head cover – Removal and installation

1. Remove cylinder head cover with gasket from cylinder head.
2. Clean installation surface.
3. Check condition of gasket in cylinder head cover.
4. Replace damaged gasket(s).
5. Install cylinder head cover with screws.



Final steps

1. Slide rubber sleeves onto the relevant pipe connection.
2. Tighten all clamps.

TIM-ID: 0000000019 - 003

6.4 Injection Valve / Injector

6.4.1 Injector – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Injector	(→ Spare Parts Catalog)	

Replacing injector

▶ Remove injector and install new injector (→ Page 49).

TIM-ID: 0000000022 - 013

6.4.2 Injector – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation device	F6790085	1
Puller	F6790636	1
Fuel suction device	F30378207	1
Torque wrench, 0.5-5 Nm	0015384230	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Adapter	F30006234	1
Open-end socket wrench, 19 mm	F30453236	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot wrench, 22 mm	F30027425	1
Double-head box wrench	F30011450	1
Open-end socket wrench, 24 mm	F30453238	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

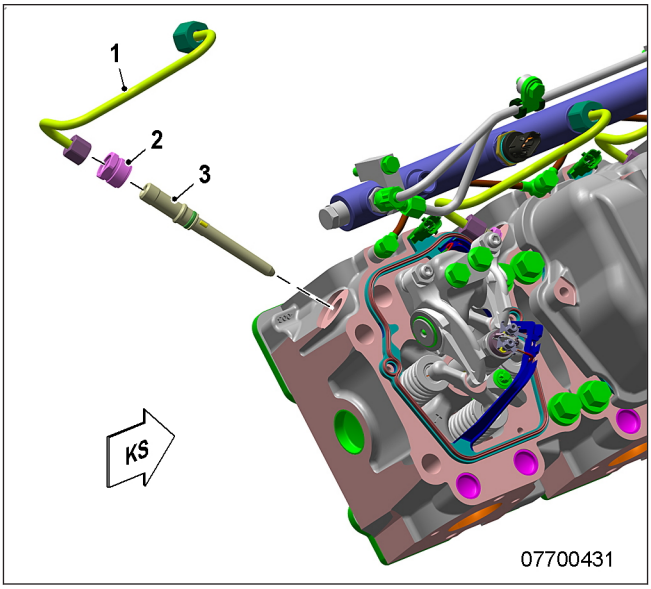
Preparatory steps

1. Shut off fuel supply line.
2. Drain fuel (→ Page 57).
3. Remove cylinder head cover (→ Page 47).

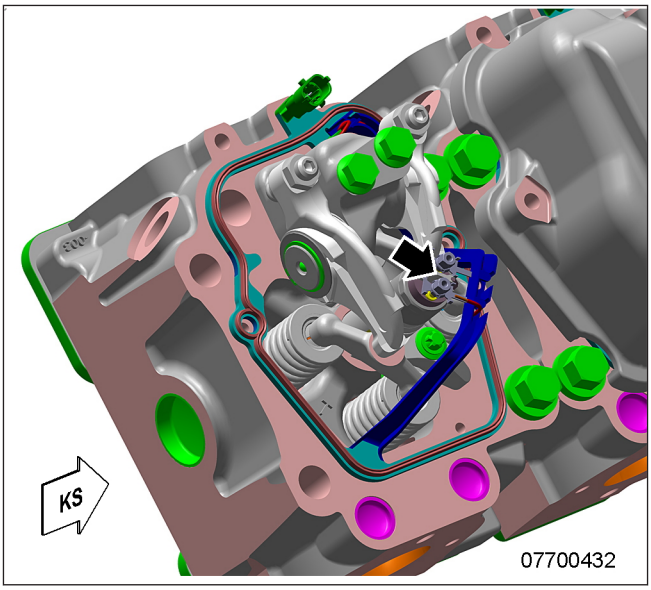
TIM-ID: 0000023980 - 002

Removing injector

1. Remove fuel line (1).
2. Unscrew union nut (2).
3. Pull out pressure pipe neck (3).
4. Extract fuel from the exposed bores using the suction device.



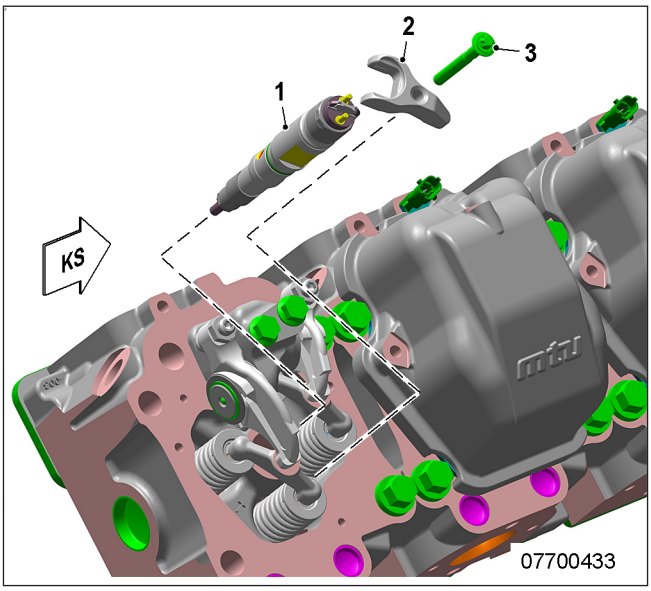
5. Disconnect terminals (arrow) on injector and pull out cable lugs.
6. Remove gasket.



7. Remove screw (3).

Note: Screw (3) may be installed only once.

8. Take off hold-down clamp (2).
9. Use the puller to pull out injector (1).
10. After removal, seal all openings with suitable covers.



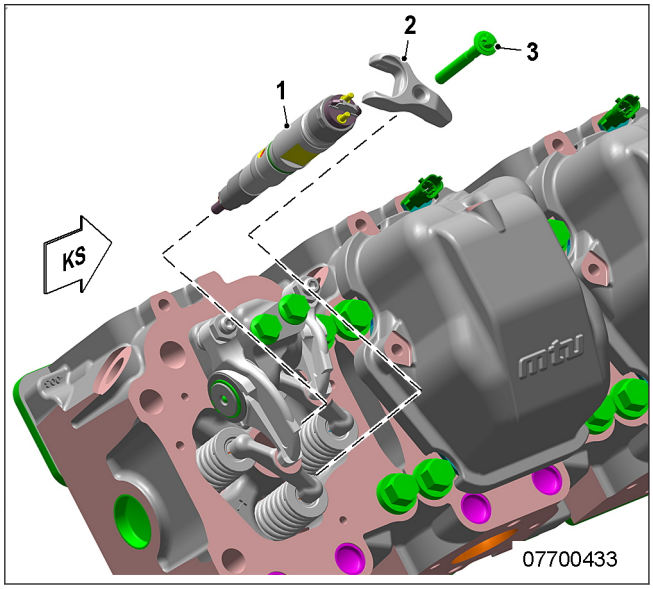
TIM-ID: 0000023980 - 002

Installing injector

1. Remove all covers before installation.
2. Clean sealing surface on cylinder head and protective sleeve.
3. Coat sealing ring on injector (1) with grease.

Note: Use either the installation tool or the hold-down clamp to press injector (1) into the cylinder head.

4. Align square on injector (1) with the seat in the hold-down clamp (2) and insert injector by hand straight into the cylinder head.
5. Place hold-down clamp (2) in position by hand, ensuring the position is correct.



Installation without installation device

1. Screw in new screw (3) and press injector (1) carefully into the cylinder head by tightening screw (3).

Name	Size	Type	Lubricant	Value/Standard
Screw	M8	Preload torque		2 Nm +2 Nm

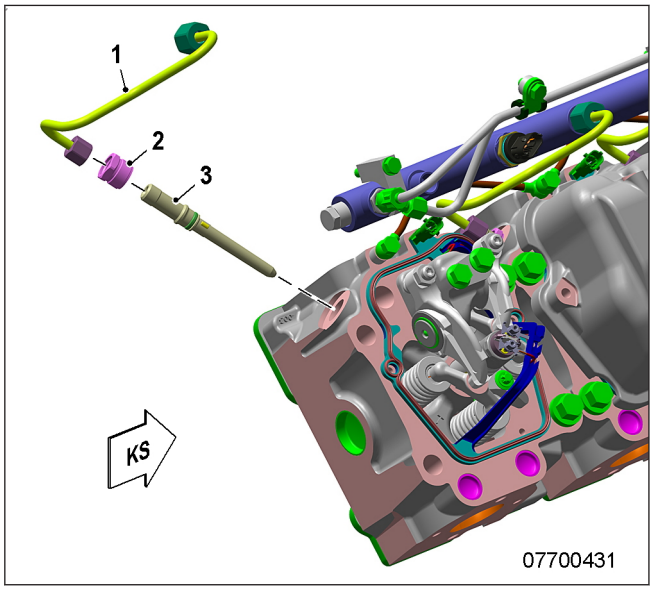
2. Release screw (3) again and relieve hold-down clamp.

Installation with installation device

1. Place installation tool on hold-down clamp to press injector (1) carefully into the cylinder head.
2. Place clamping piece (2) in correct position, screw in screw (3) and tighten snug-fit.

Installing pressure pipe neck

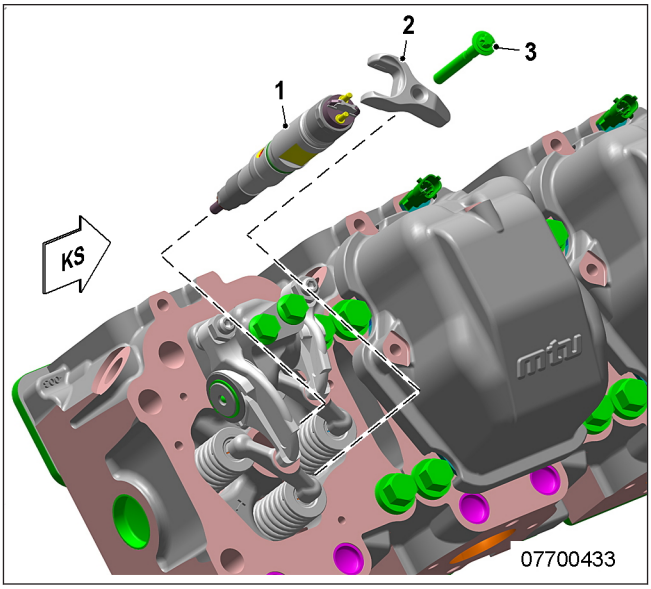
1. Blow out fuel line (1) and pressure pipe neck (3) with compressed air.
2. Coat sealing ring with grease.
3. Coat sealing cone of pressure pipe neck (3) with engine oil.
4. Slide pressure pipe neck (3) into cylinder head until it makes contact with the sealing ring.
5. Press in pressure pipe neck (3) by hand until it will not go any further.
6. Align HP connection of injector with pressure pipe neck (3).



7. Coat thread and shoulder of union nut (2) with engine oil and tighten with torque wrench to the specified tightening torque.

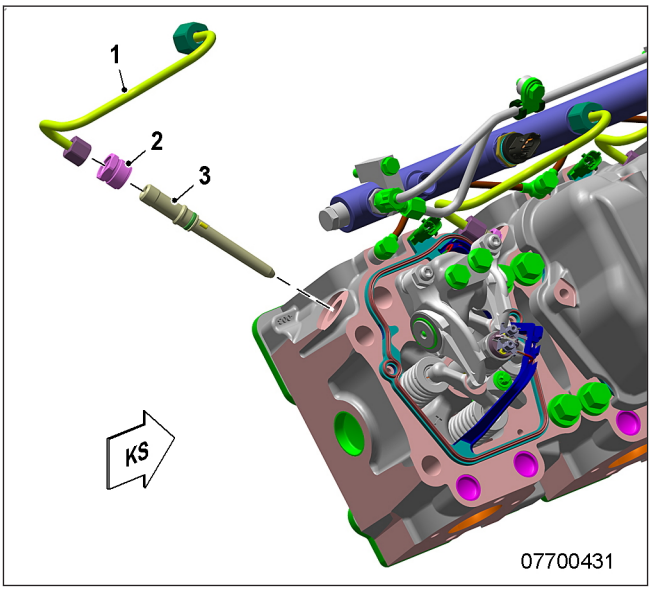
Name	Size	Type	Lubricant	Value/Standard
Union nut		Preload torque	(Engine oil)	15 Nm + 5 Nm

TIM-ID: 0000023980 - 002



8. Use torque wrench to tighten screw (3) for hold-down clamp (2) to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M8	Tightening torque	(Engine oil)	40 Nm +4 Nm



9. Tighten union nut (2) on pressure pipe neck with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut		Tightening torque		45 Nm +5 Nm

Installing fuel line

1. Coat thread and shoulder of union nuts on fuel line (1) with engine oil.

Note: Position fuel line, ensuring it is free of tension.

2. Position fuel line (1) so that the union nut with the torque specification faces the fuel rail and the end without torque specification faces the pressure pipe neck (2), and tighten snug-fit.

3. Tighten union nut of fuel line (1) on fuel rail to the specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Union nut		Tightening torque	(Engine oil)	45 Nm +5 Nm

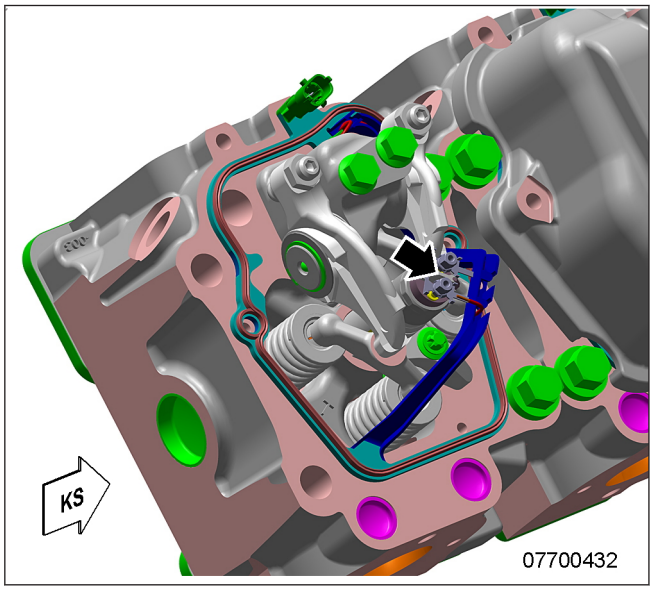
TIM-ID: 0000023980 - 002

4. Tighten union nut of fuel line (1) on pressure pipe neck (2) to the specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Union nut		Tightening torque	(Engine oil)	37 Nm +3 Nm

Fitting gasket and connecting injector cable

1. Place gasket on cylinder head, ensuring correct installation position.



2. Push cable lugs under the terminals (arrow) on the injector and tighten with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut	M4	Tightening torque	(Engine oil)	1.5 Nm ±0.25 Nm

Final steps

1. Install cylinder head cover (→ Page 47).
2. Open fuel supply line.
3. Vent fuel system (→ Page 56).

TIM-ID: 0000023980 - 002

6.5 Fuel System

6.5.1 HP fuel line and pressure pipe neck – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Adapter	F30006234	1
Socket wrench, 19 mm	F30025897	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot wrench, 22 mm	F30027425	1
Double box wrench	F30011450	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
Pressure pipe neck	(→ Spare Parts Catalog)	
HP fuel line	(→ Spare Parts Catalog)	

WARNING

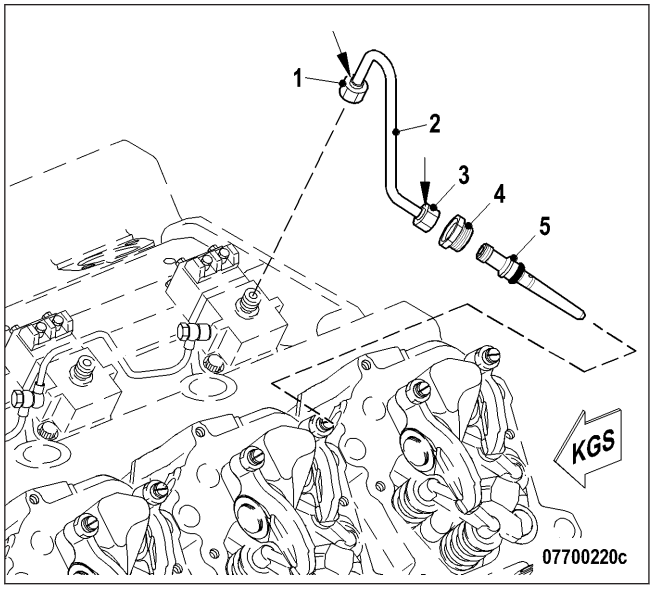
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Preparatory steps

1. Shut off fuel supply line.
2. Drain fuel (→ Page 57).

TIM-ID: 0000012538 - 001

HP fuel line and pressure pipe neck – Replacement



1. Remove leak-off fuel line from cylinder head.
2. Remove HP fuel line (2).
3. Remove thrust screw (4).
4. Withdraw pressure pipe neck (5).
5. Coat sealing ring of new pressure pipe neck with grease.
6. Coat sealing cone of pressure pipe neck with engine oil.
7. Insert pressure pipe neck into cylinder head until it is in contact with the sealing ring.
8. Fully press in pressure pipe neck by hand.
9. Tighten thrust screw (4) to specified torque 40 Nm ±5 Nm using torque wrench.
10. Coat mating face between union nut and HP fuel line, ball seal and thread on both ends of the new HP fuel line (2) with engine oil.
11. Install new HP fuel line (2).
12. Observe marking on union nut (1).
    - Use torque wrench to tighten union nut (1) with marking “35+3 Nm” to specified tightening torque 35 Nm +3 Nm.
    - Tighten union nut (1) without marking to specified torque 30 Nm +5 Nm.
13. Observe marking on union nut (3).
    - Use torque wrench to tighten union nut (3) with marking “35+3 Nm” to specified tightening torque 35 Nm +3 Nm.
    - Tighten union nut (3) without marking to specified torque 25 Nm +3 Nm.
14. Install leak-off fuel line on cylinder head.

Final steps

1. Open fuel supply.
2. Vent fuel system (→ Page 56).

TIM-ID: 0000012538 - 001

6.5.2 Fuel system – Venting

Preconditions

☑ Engine is not connected to load.

Fuel system – Venting

Note: The fuel system can only be vented with the engine running.

1. Start engine (→ Page 28).
2. Operate the engine until it runs smoothly.

TIM-ID: 0000012554 - 002

6.5.3 Fuel – Draining

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel – Draining

1. Provide a suitable container in which to collect the fuel.
2. Remove fuel filter (→ Page 58).
3. Catch fuel as it runs out.
4. Install fuel filter (→ Page 58).

TIM-ID: 0000004702 - 002

6.6 Fuel Filter

6.6.1 Fuel filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

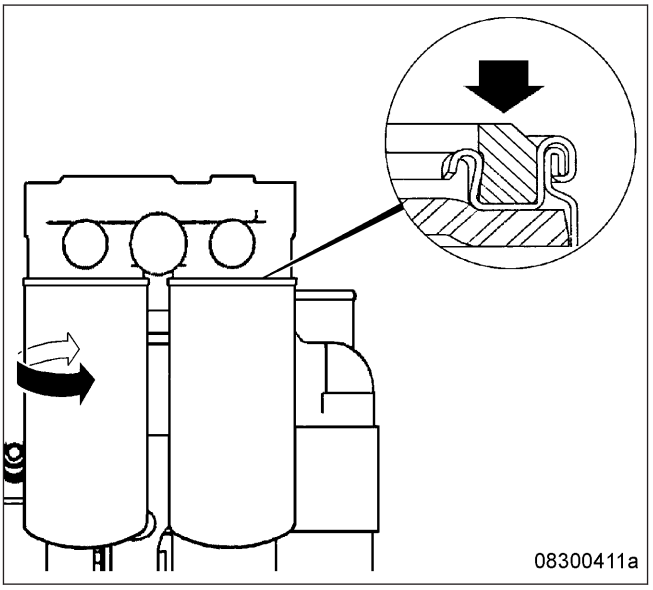
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Diesel fuel		
Easy-change filter	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel filter – Replacement

1. Remove easy-change filter using the filter wrench.
2. Clean sealing surface on filter head.
3. Check sealing ring of the new easy-change filter and moisten it with fuel.
4. Fill the new easy-change filter with clean fuel.
5. Screw on easy-change filter and tighten hand-tight.
6. Replace further fuel filters in the same way.
7. Vent fuel system (→ Page 56).



TIM-ID: 0000012700 - 002

6.6.2 Fuel prefilter – Differential pressure check and adjustment of gauge

DANGER

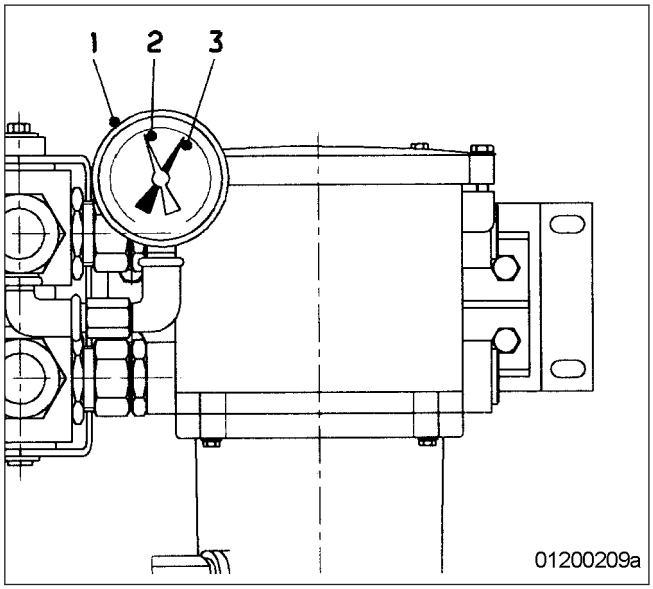
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Differential pressure gauge adjustment

1. When installing the new filter element: align adjustable pointer (2) with pressure-indicating pointer (3) of pressure gauge (1).
2. Verify that differential pressure is within the limit.



Fuel prefilter – Checking differential pressure

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure indicator of pressure gauge (3) is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 61).

TIM-ID: 0000004926 - 003

6.6.3 Fuel prefilter – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

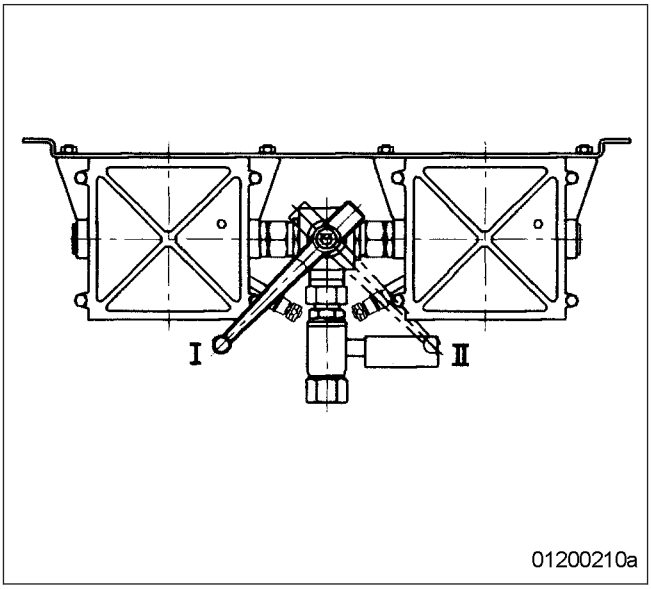
Designation / Use	Part No.	Qty.
Diesel fuel		
Seal	(→ Spare Parts Catalog)	

WARNING

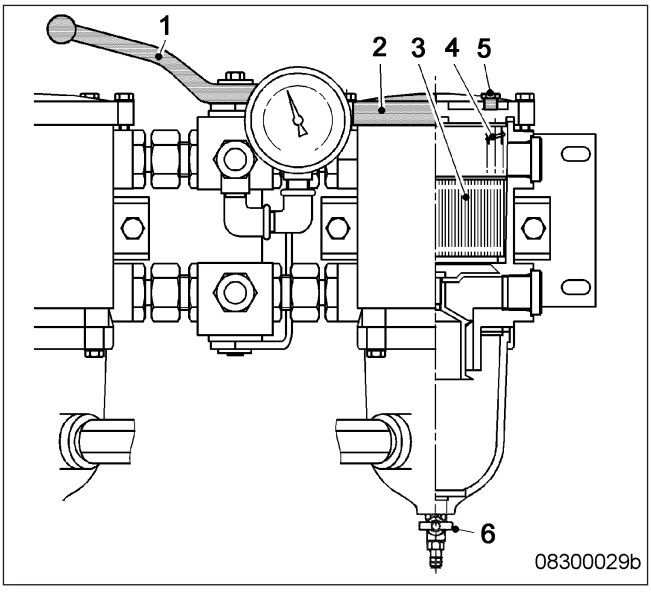
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Draining

1. Cut out the filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



2. Open threaded vent plug (5) of the filter to be drained.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and contaminants from the filter until pure fuel emerges.
5. Close drain valve (6).
6. Remove screws securing the cover and take off cover (2).
7. Fill filter housing with clean fuel.
8. Place new seal in cover (2).
9. Fit cover with gasket and secure it with screws.
10. Cut in the cut-out filter again.
11. Close threaded vent plug (5) when fuel emerges from system.



TIM-ID: 0000004933 - 004

6.6.4 Fuel prefilter – Flushing

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Fuel		
Gasket	(→ Spare Parts Catalog)	

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

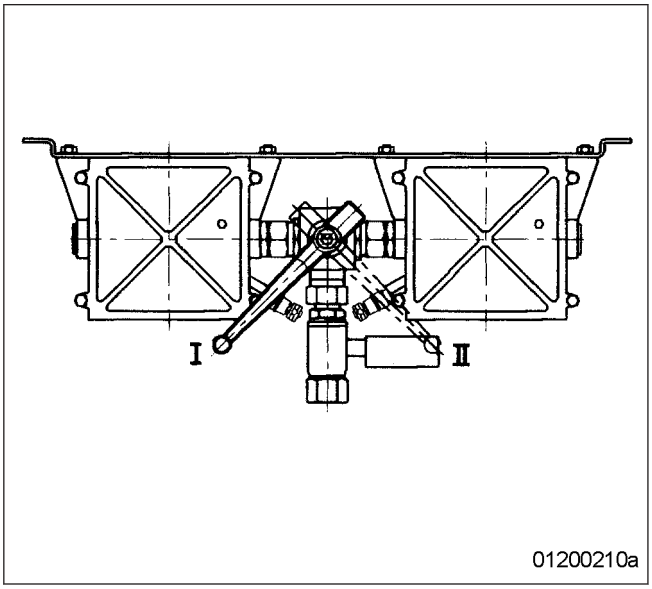
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Fuel prefilter – Flushing

1. Cut out clogged filter.
   - I Left filter cut in
   - II Right filter cut in

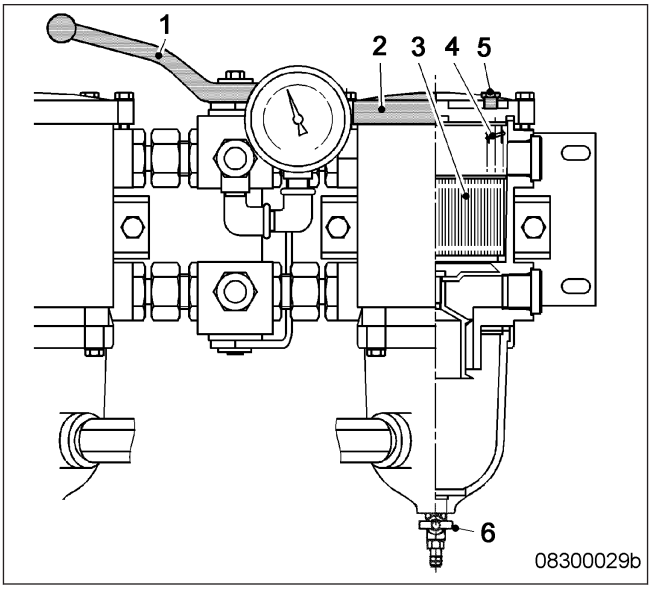


TIM-ID: 0000004937 - 015

2. Open threaded vent plug (5) of filter to be flushed.
3. Unlock drain valve (6) by pressing valve toggle, open it and drain fuel.

Result: Fuel flows from filtered side back to the unfiltered side, flushing the filter deposits downwards out of the filter.

4. Close threaded vent plug (5) and drain valve (6).



Fuel prefilter – Topping up with fuel

1. Stop engine (→ Page 31) and disable engine start.
2. Remove screws for cover and take off cover (2).
3. Fill filter housing with clean fuel.
4. Place new gasket in cover (2).
5. Fit cover with gasket and secure it with screws.
6. Check differential pressure (→ Page 59).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element of fuel prefilter (→ Page 63).

TIM-ID: 0000004937 - 015

6.6.5 Fuel prefilter – Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

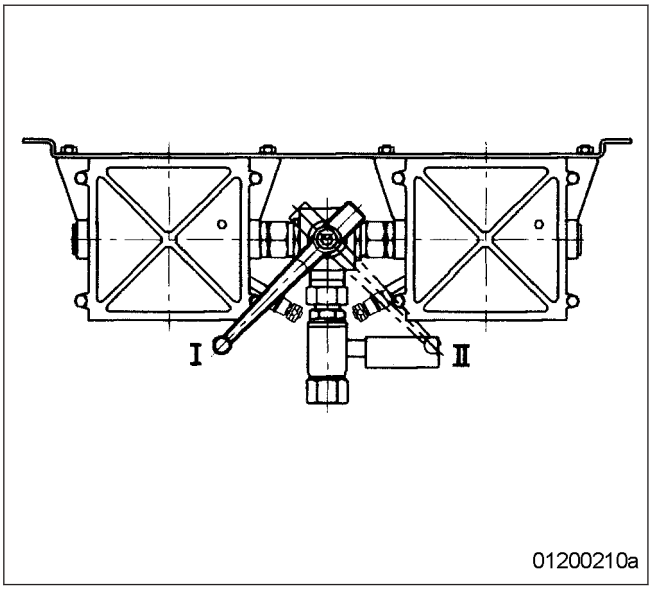
Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Seal	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

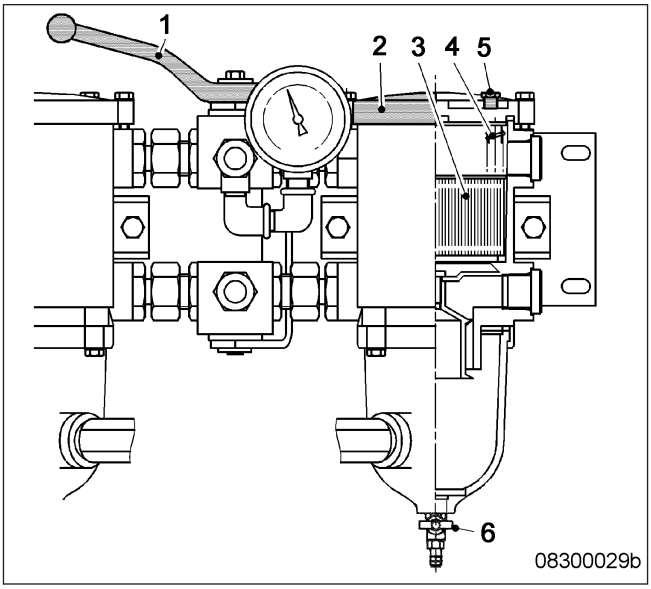
Replacing filter element

1. Cut out the contaminated filter.
   - I Left filter cut in
   - II Right filter cut in



TIM-ID: 0000004946 - 004

2. Open threaded vent plug (5) of contaminated filter.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and contaminants from the filter.
5. Close drain valve (6).
6. Remove screws securing the cover and take off cover (2).
7. Remove spring housing (4) and filter element (3).
8. Insert new filter element (3) and spring housing (4).
9. Fill filter housing with clean fuel.
10. Place new seal in cover (2).
11. Fit cover with gasket and secure it with screws.
12. Cut in the cut-out filter again.
13. Close threaded vent plug (5) when fuel emerges.
14. Set adjustable pointer of differential pressure gauge (→ Page 59).



TIM-ID: 0000004946 - 004

6.7 Air Filter

6.7.1 Air filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

For air filter replacement, carry out operations as specified by the manufacturer – filter is plant/vehicle manufacturer's supply.

TIM-ID: 0000013387 - 003

6.8 Air Intake

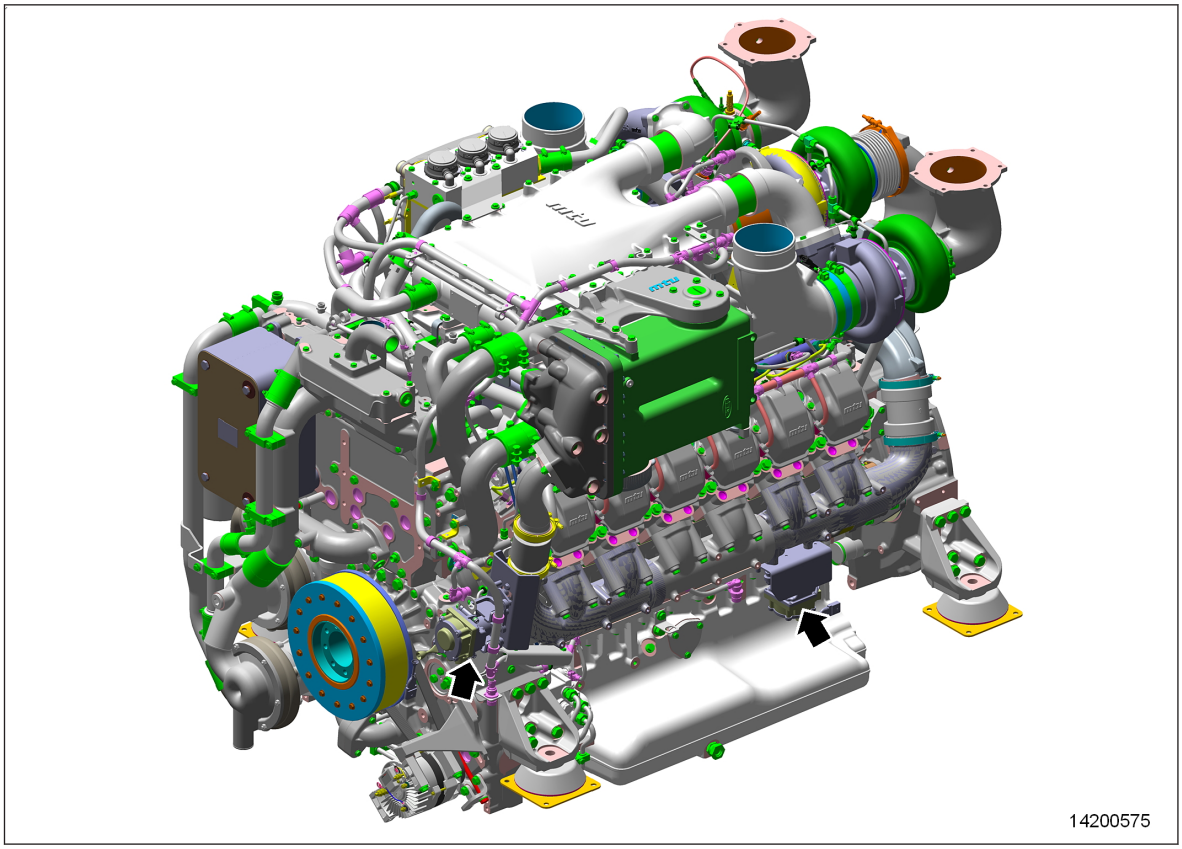
6.8.1 Service indicator – Check

See manufacturer's documentation.

TIM-ID: 0000005482 - 003

6.9 Exhaust Gas Recirculation

6.9.1 Exhaust gas recirculation flaps – Overview



TIM-ID: 0000024288 - 001

6.9.2 Exhaust gas circulation - Checking flap operation

Preconditions

☑ Engine is stopped and starting disabled.

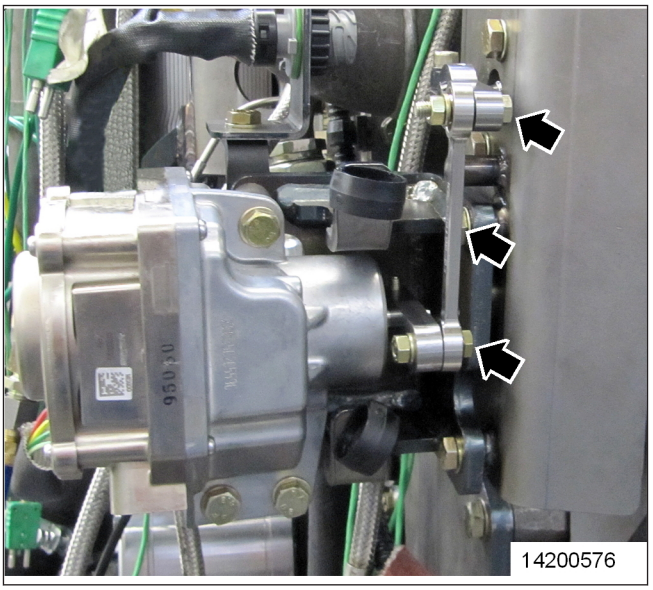
WARNING

Component is hot.
Risk of burning!
- Wear protective gloves.

Checking exhaust flap operation

1. For installation position of exhaust flaps, refer to overview (→ Page 67).
2. Check operability and ease of movement of exhaust flaps and control linkage by moving the assembly at the points (arrowed) shown in the illustration.

Result: If exhaust flap is jammed or sluggish:Contact Service.



TIM-ID: 0000024000 - 001

6.10 Lube Oil System, Lube Oil Circuit

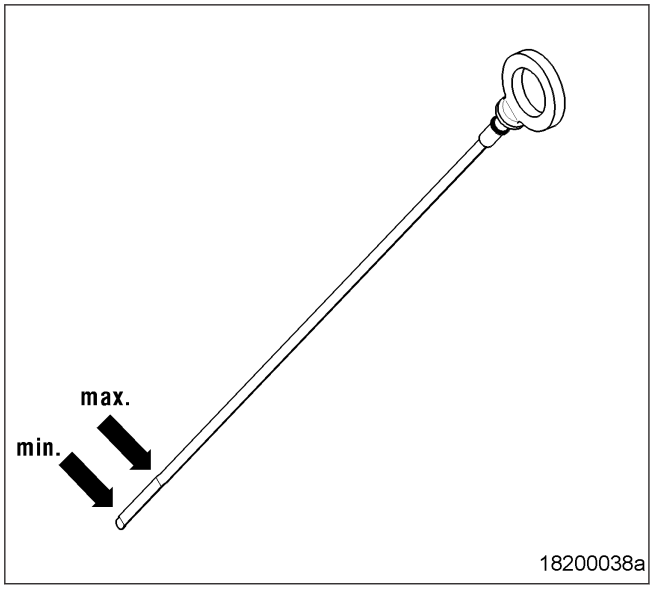
6.10.1 Engine oil – Level check

Preconditions

☑ Engine is stopped and starting disabled.

Oil level check prior to engine start

1. Withdraw oil dipstick from guide tube and wipe it.
2. Insert oil dipstick into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. Top up to "max." if required (→ Page 70).
5. Insert oil dipstick into guide tube up to the stop.



Oil level check after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert oil dipstick into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between “min.” and "max." marks.
4. Top up to "max." if required (→ Page 70).
5. Insert oil dipstick into guide tube up to the stop.

TIM-ID: 0000000032 - 002

6.10.2 Engine oil – Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Oil change without semirotary hand pump: Draining oil at drain plug on oil pan

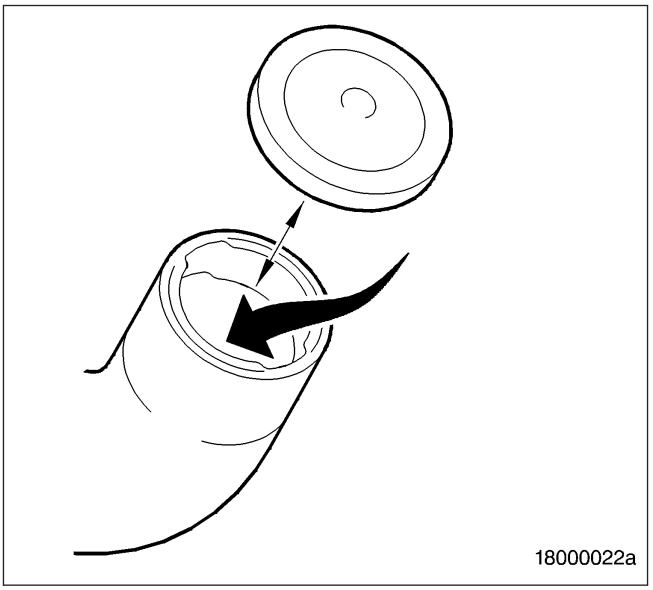
1. Provide a suitable container to collect the oil.
2. Remove drain plug and drain oil.
3. Install drain plug with new sealing ring.
4. Replace engine oil filter (→ Page 71).

Oil change with semirotary hand pump: Oil extraction

1. Provide a suitable container to collect the oil.
2. Extract all oil from oil pan using the semirotary hand pump.
3. Replace engine oil filter (→ Page 71).

Filling with new oil

1. Open cover on filler neck.
2. Pour oil in at filler neck up to "max." mark at oil dipstick.
3. Close cover on filler neck.
4. Check engine oil level (→ Page 69).
5. After oil change and filter replacement, bar engine with starting system (→ Page 42).



TIM-ID: 0000000031 - 005

6.11 Oil Filtration / Cooling

6.11.1 Engine oil filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

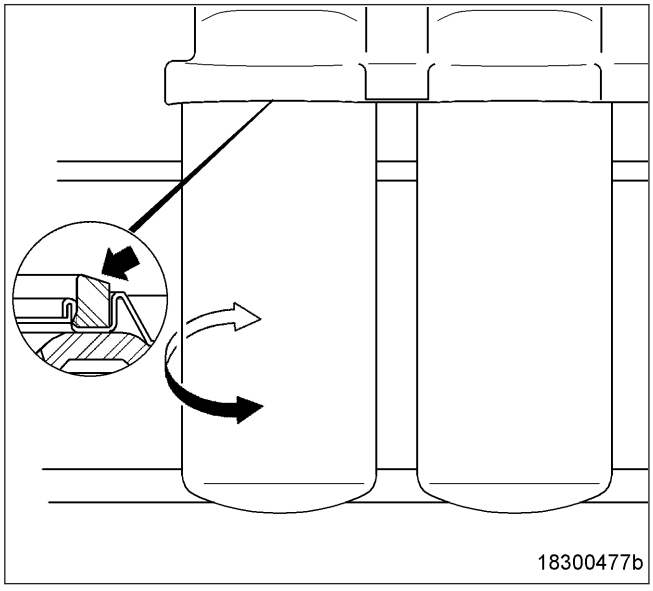
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Engine oil filter – Replacement

1. Remove oil filter with filter wrench.
2. Clean the sealing surface on the oil filter housing.
3. Check condition of the new sealing ring and coat it with oil.
4. Screw on oil filter and tighten hand-tight.
5. Replace other oil filters in the same way.
6. After each oil change and filter replacement, bar engine with starting system (→ Page 42).
7. Check oil level (→ Page 69).



TIM-ID: 0000014212 - 002

6.11.2 Centrifugal oil filter – Cleaning and filter sleeve replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Cold cleaner (Hakutex 60)	X00056750	1
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

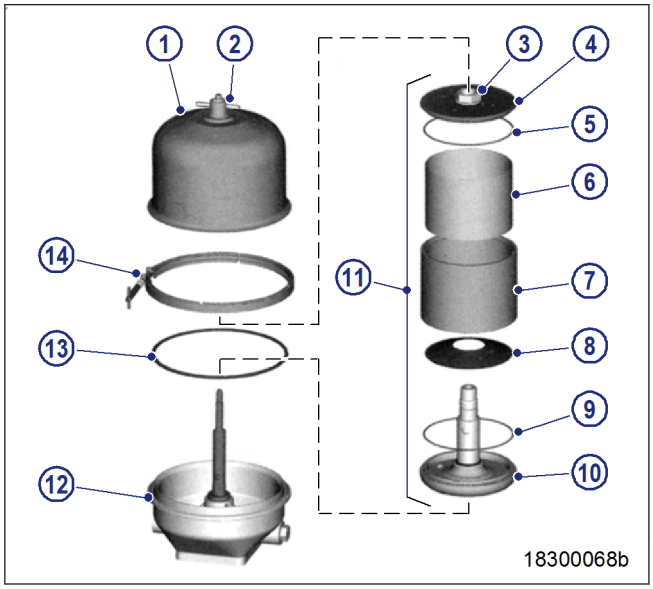
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

TIM-ID: 0000000934 - 008

Centrifugal oil filter cleaning and filter sleeve replacement



1. Remove clamp (14).
2. Release cover screw (2) and take off cover (1).
3. Carefully lift rotor (11), allow oil to drain and remove from housing.
4. Holding the rotor (11) firmly, release rotor cover nut (3).
5. Take off rotor cover (4).
6. Remove filter sleeve (6).
7. Measure thickness of oil residues on filter sleeve (6).
8. If maximum layer thickness of oil residues exceeds 45 mm, shorten maintenance interval.
9. Disassemble rotor tube (7), conical disk (8) and rotor base (10).
10. Wash rotor cover (4), rotor tube (7), conical disk (8) and rotor base (10) with cold cleaner.
11. Blow out with compressed air.
12. Check sealing ring (9), fit new one if necessary.
13. Assemble rotor tube (7), conical disk (8) and rotor base (10) with sealing ring (9).
14. Insert new filter sleeve (6) in rotor tube (7) with the smooth paper surface facing the outer wall.
15. Check sealing ring (5), fit new one if necessary.
16. Mount rotor cover (4) with sealing ring (5).
17. Tighten rotor cover nut (3) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque		35 Nm to 45 Nm

18. Place rotor (11) in housing (12) and check for ease of movement.
19. Check sealing ring (13), fit new one if necessary.
20. Fit sealing ring (13) on housing (12).
21. Fit cover (1).
22. Fit cover screw (2) by hand.
23. Install clamp (14) and tighten with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		8 Nm to 10 Nm

24. Tighten cover nut (2) with torque wrench to the specified torque.

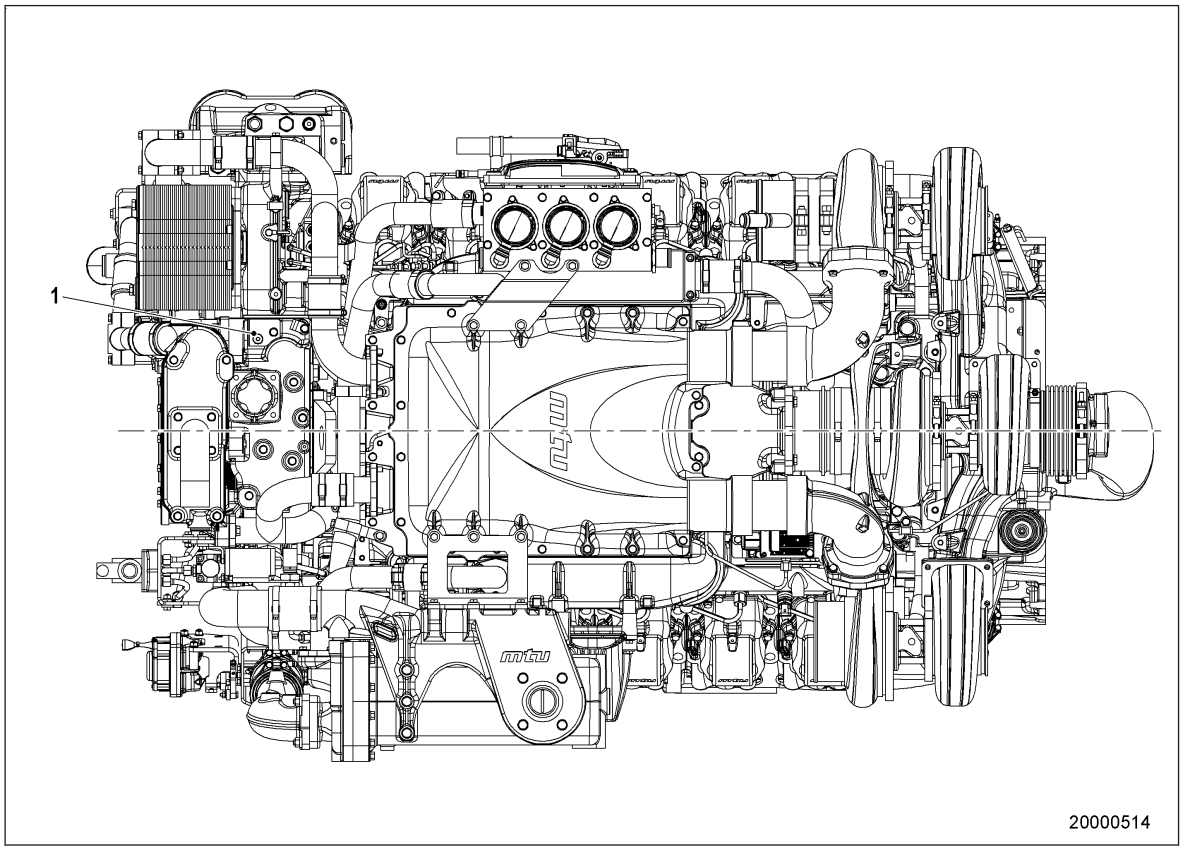
Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		5 Nm to 7 Nm

TIM-ID: 0000000934 - 008

6.12 Coolant Circuit, General, High-Temperature Circuit

6.12.1 Drain and vent points

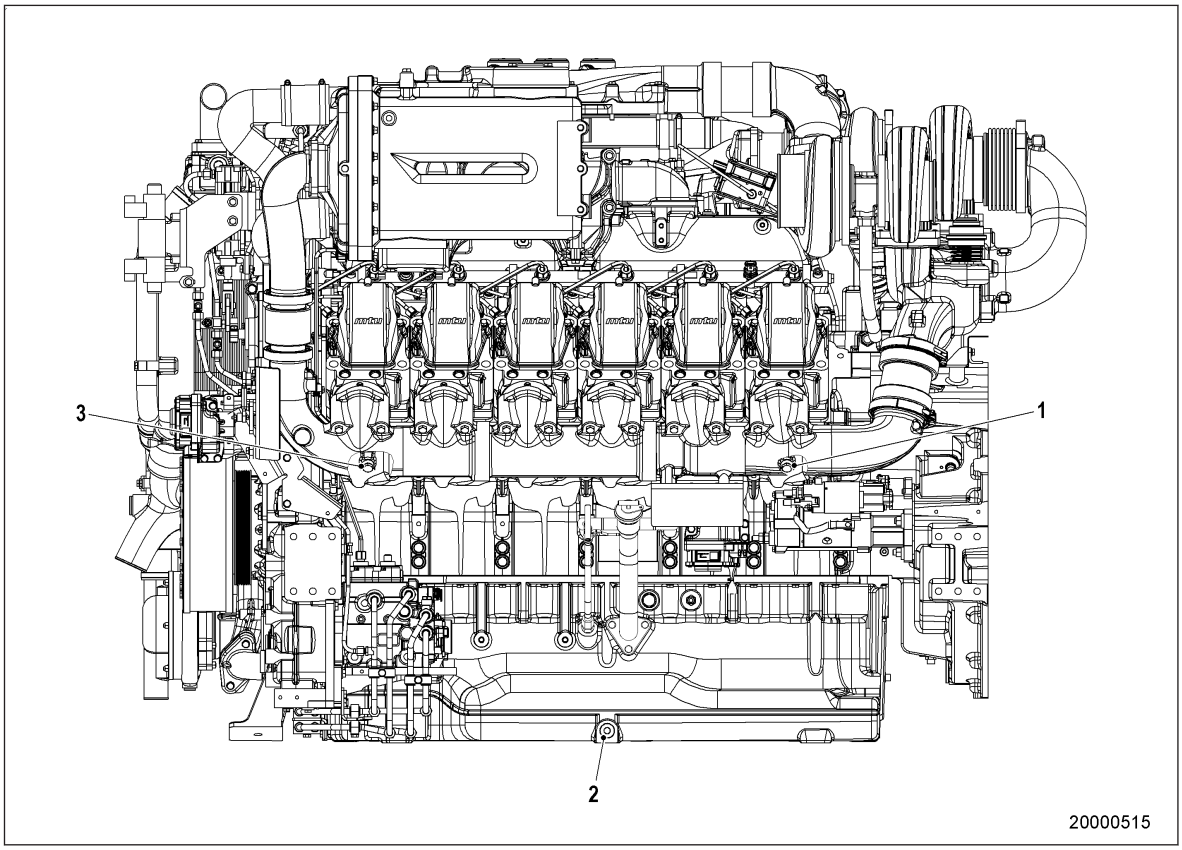
12 V, 16 V



1 Engine coolant vent

TIM-ID: 0000025286 - 001

Left side



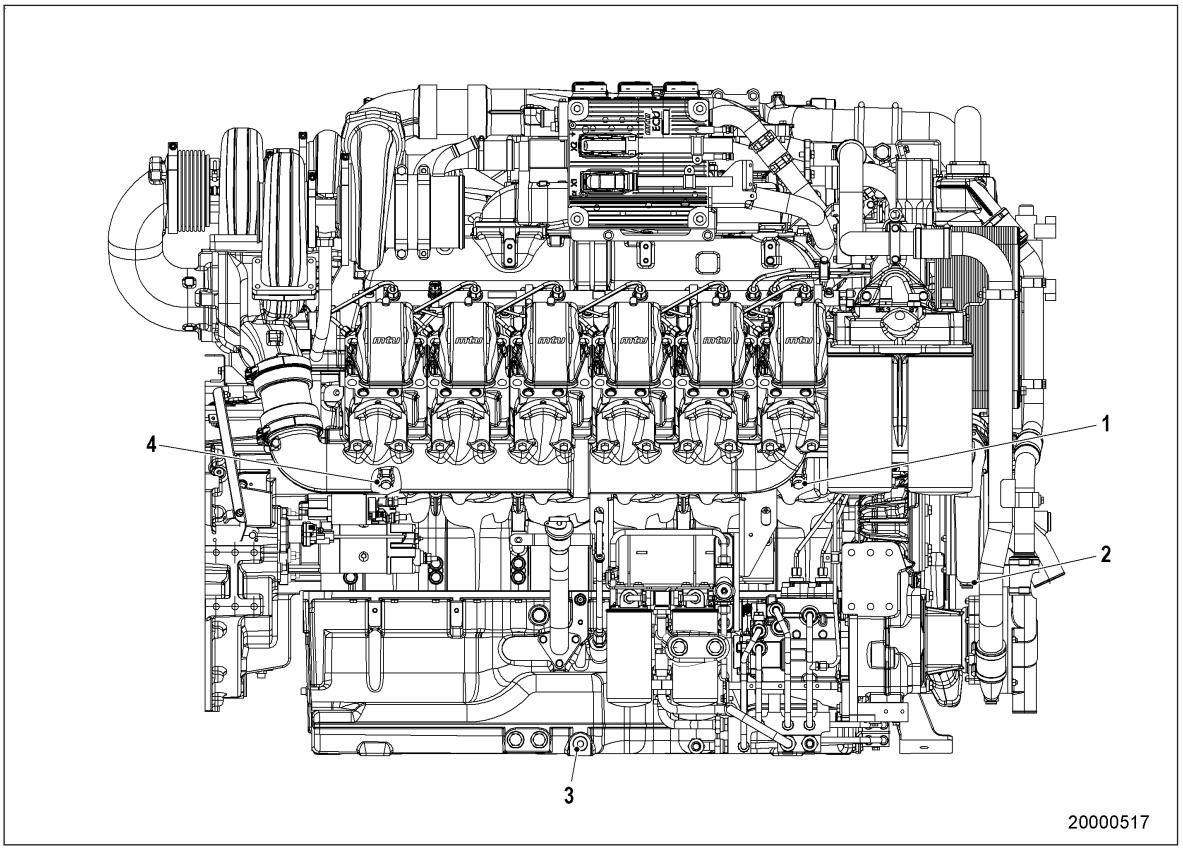
1 Engine coolant drain plug

2 Oil drain plug

3 Engine coolant drain plug

TIM-ID: 0000025286 - 001

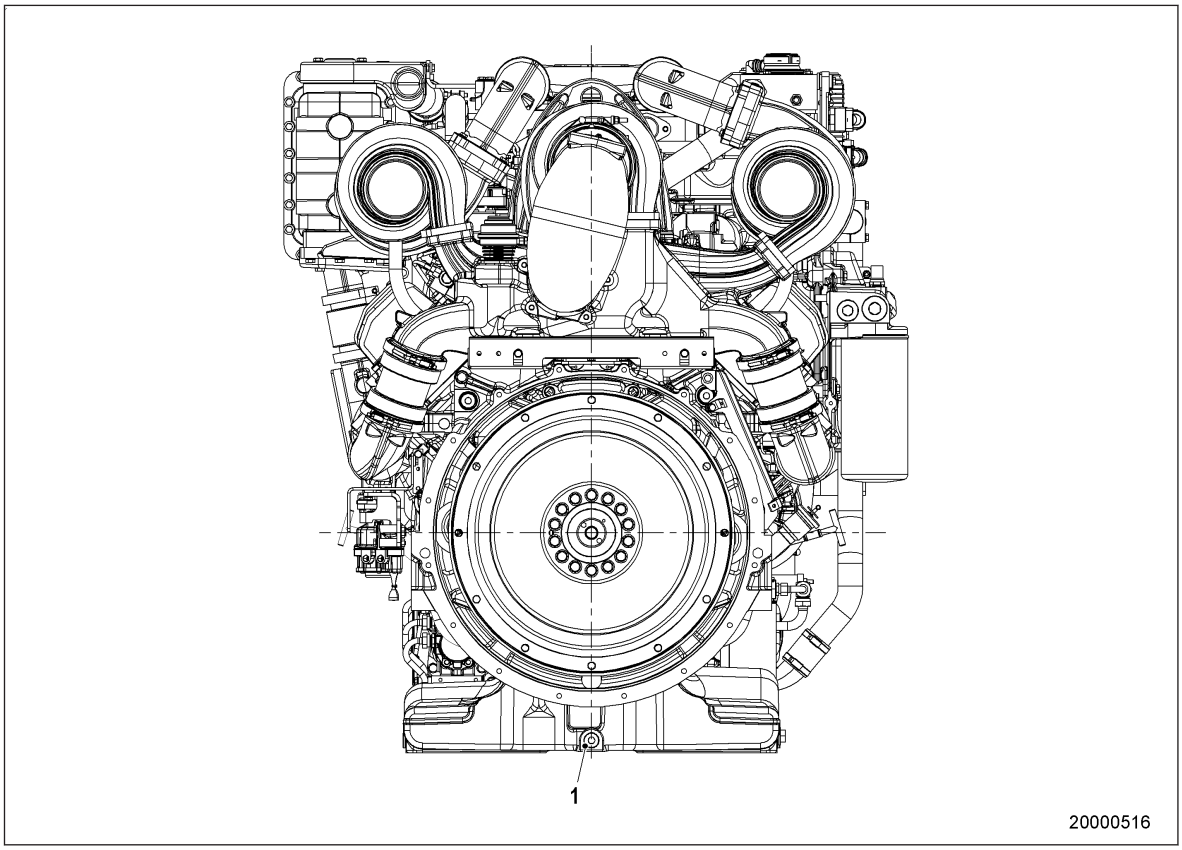
Right side



1 Engine coolant drain plug
2 Engine coolant drain plug
3 Oil drain plug
4 Engine coolant drain plug

TIM-ID: 0000025286 - 001

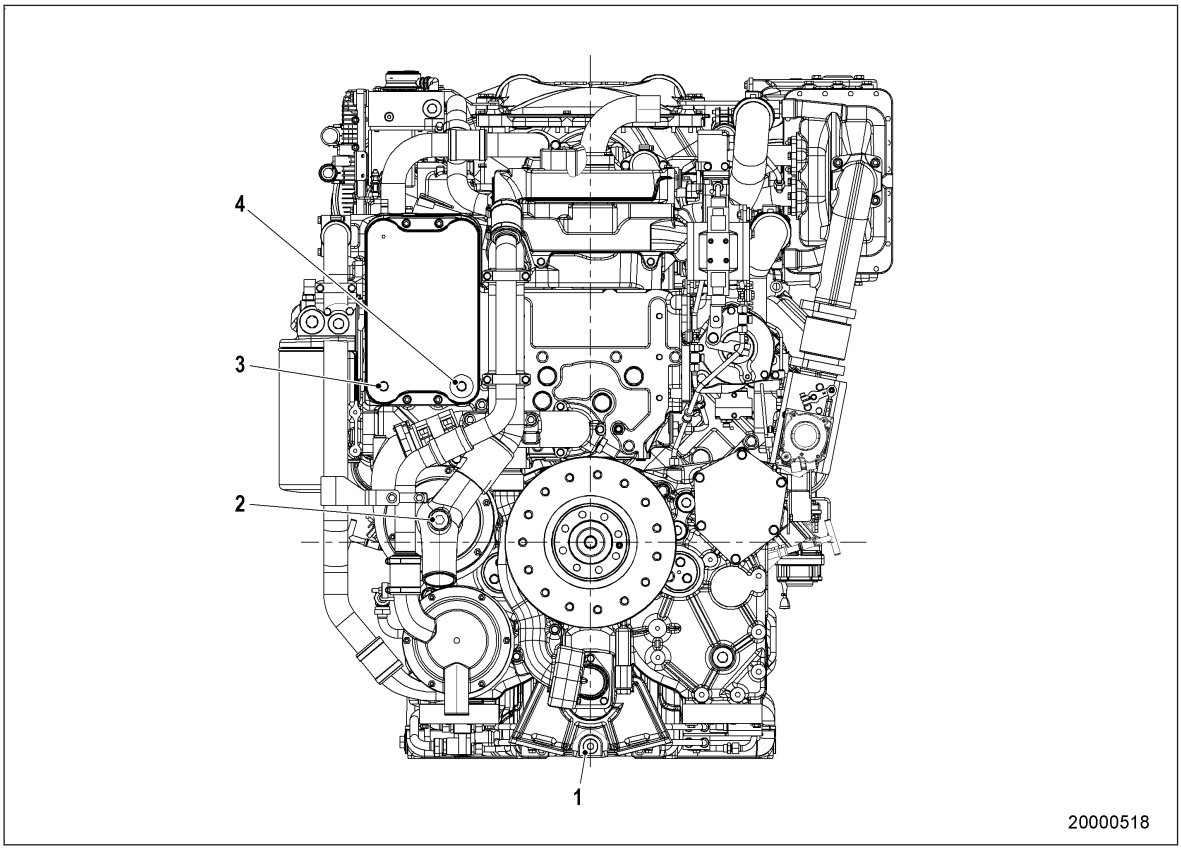
Driving end (KS)



1 Oil drain plug

TIM-ID: 0000025286 - 001

Free end (KGS)



1 Oil drain plug
2 Engine coolant filling plug
3 Oil drain plug
4 Engine coolant drain plug

TIM-ID: 0000025286 - 001

6.12.2 Engine coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

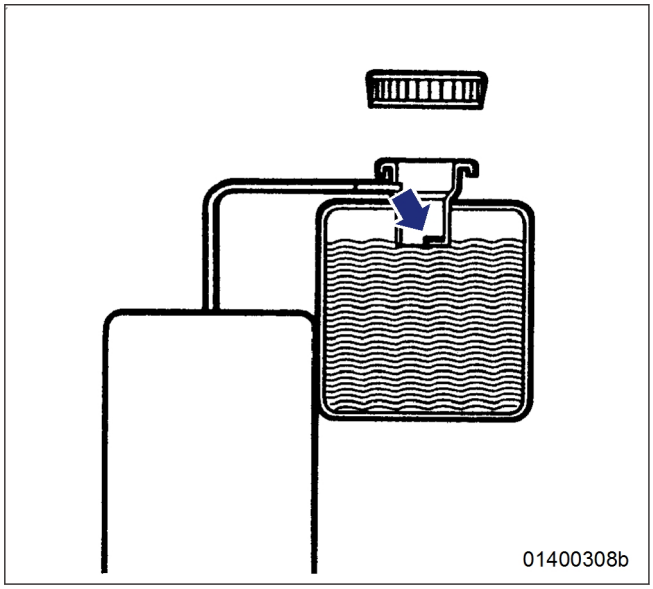
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye or at the marking plate).
4. Top up with treated coolant as necessary (→ Page 82).
5. Check and clean breather valve.
6. Place breather valve on filler neck and close.



Coolant-level check by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 82).

TIM-ID: 0000000037 - 004

6.12.3 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant – Change

1. Drain engine coolant (→ Page 81).
2. Fill with engine coolant (→ Page 82).

TIM-ID: 0000000036 - 030

6.12.4 Engine coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

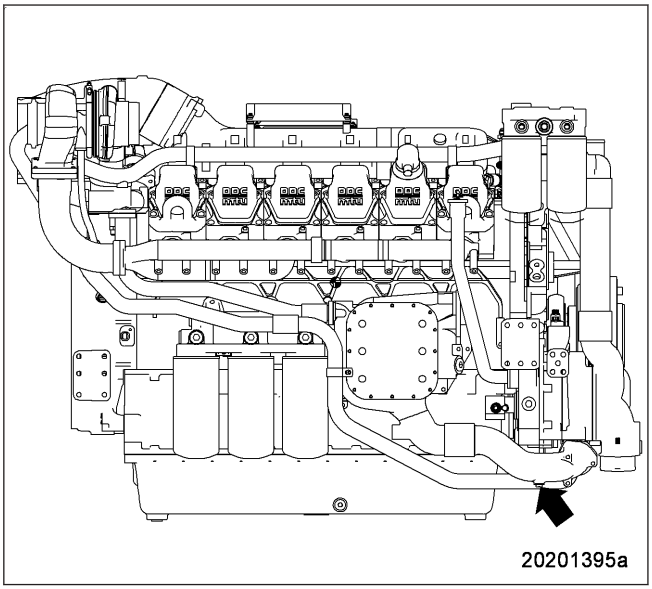
Designation / Use	Part No.	Qty.
Sealing rings	(→ Spare Parts Catalog)	

WARNING

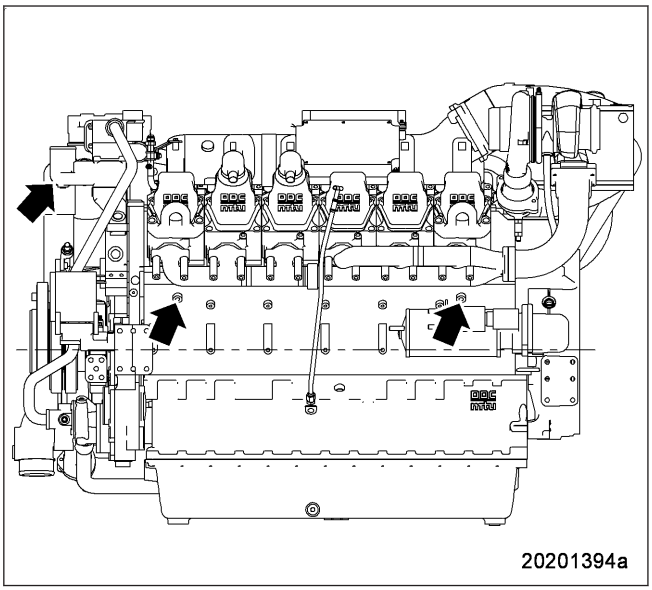
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Engine coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheating unit, if fitted.
3. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
4. Continue to turn breather valve counter-clockwise and remove.
5. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
6. Open drain plug at drain point in coolant line to engine coolant cooler and drain coolant.
7. Draining of residual coolant:
   - At the preheating unit, if fitted.
8. Drain engine coolant:
   - At the engine coolant pump elbow;
   - At the crankcase, left and right sides;
   - At the thermostat housing.
9. Close all drain valves and install drain plugs with new sealing rings.
10. Set breather valve onto filler neck and close it.



20201395a



20201394a

TIM-ID: 0000014583 - 001

6.12.5 Engine coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

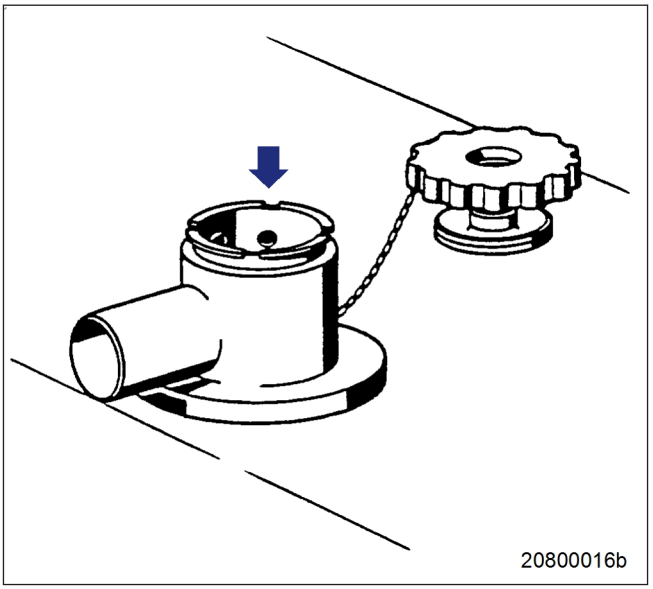
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

CAUTION

Cold coolant in hot engine can cause thermal stress.
Formation of cracks in components!
- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.



TIM-ID: 0000000034 - 005

Engine coolant – Filling

1. Fill coolant through filler neck on expansion tank or through filling line until coolant level reaches lower edge of cast-in eye or marking plate.
2. Check proper condition of breather valve, clean sealing faces if required.
3. Fit breather valve and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 79), top up with coolant if required.

TIM-ID: 0000000034 - 005

6.12.6 Engine coolant pump – Relief bore check

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

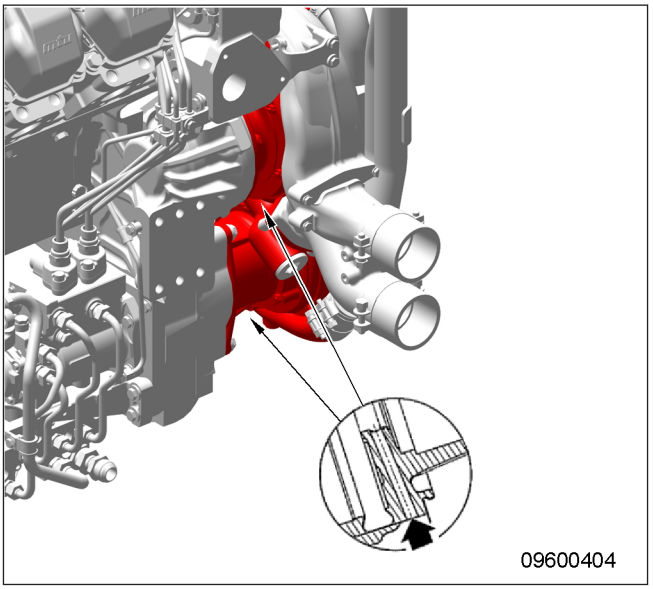
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore is dirty:
   - Stop engine (→ Page 31) and disable engine start.
   - Clean relief bore with a wire.



TIM-ID: 0000025150 - 001

6.12.7 Engine coolant – Sample extraction and analysis

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Engine coolant – Sample extraction and analysis

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from expansion tank and dispose of oil.
4. Draw off approx. 1 liter coolant and drain into a clean container.
5. Using the equipment and chemicals from the MTU test kit, examine coolant for:
   - antifreeze concentration;
   - corrosion inhibitor concentration;
   - pH value.
6. Fit breather valve and close it.
7. Engine coolant change intervals (→ MTU Fluids and Lubricants Specifications A001061/..).

TIM-ID: 0000014607 - 002

6.12.8 Coolant filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

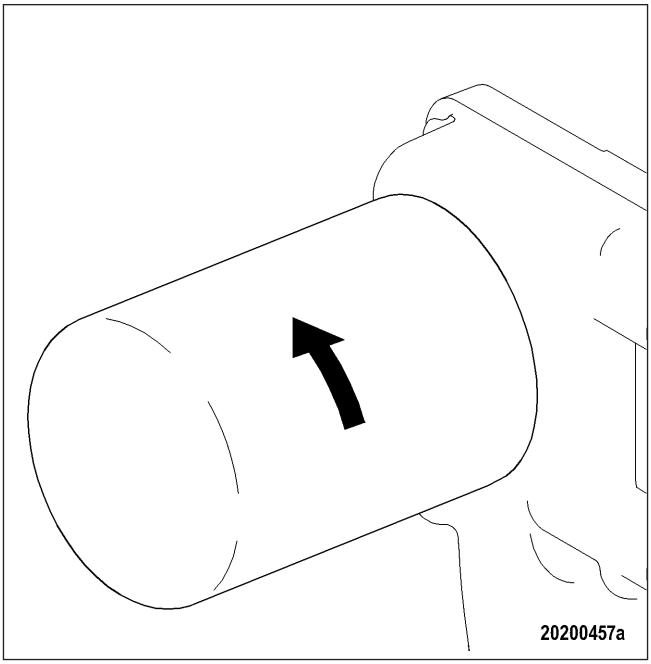
Designation / Use	Part No.	Qty.
Oil filter wrench	F30379104	1
Coolant filter	(→ Spare Parts Catalog)	

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Coolant filter – Replacement

1. Turn breather valve of coolant expansion tank counterclockwise (→ Page 14) to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Remove coolant filter using the oil filter wrench.
4. Clean the sealing face on the adapter.
5. Coat sealing ring of the new coolant filter with engine oil.
6. Install and tighten coolant filter by hand.
7. Close breather valve.
8. Check coolant level (→ Page 79).

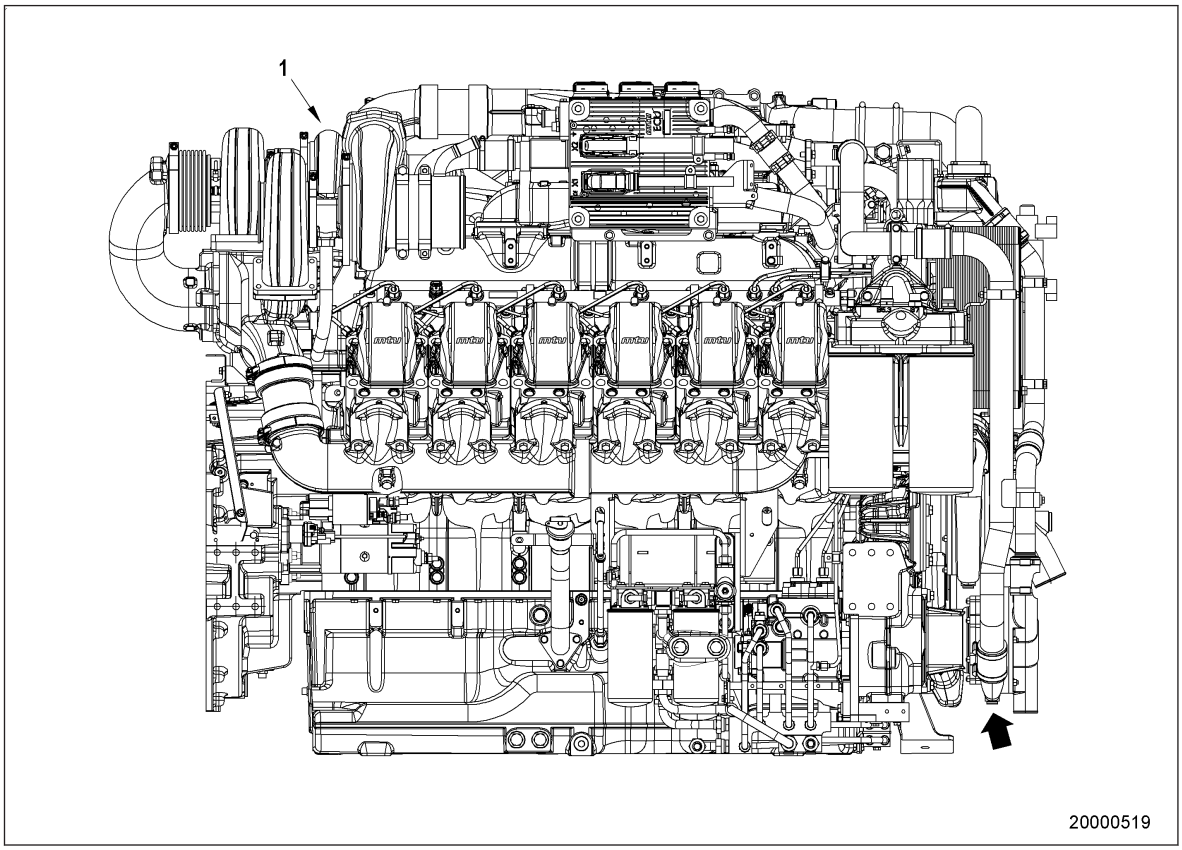


TIM-ID: 0000006921 - 004

6.13 Low-Temperature Circuit

6.13.1 Intercooler – Vent and drain points

12 V, 16 V



1 Intercooler vent plugs

TIM-ID: 0000025297 - 002

6.13.2 Charge-air coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

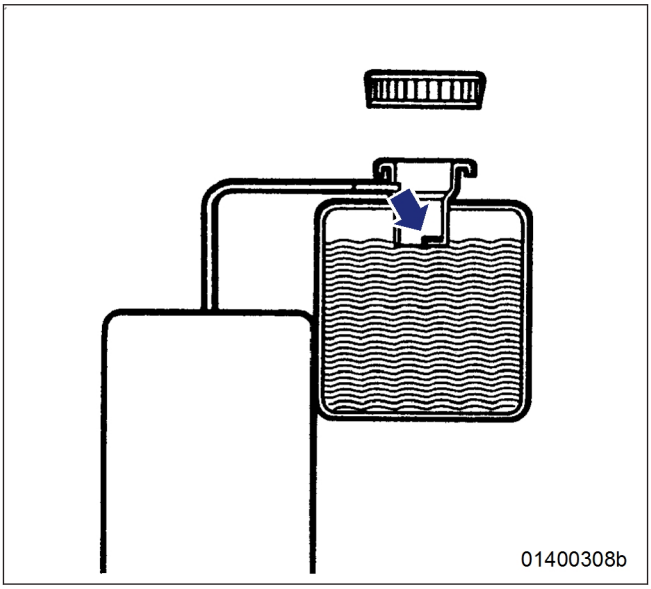
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking charge-air coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Check coolant level (coolant must be visible at marking plate).
4. Top up coolant if necessary (→ Page 90).
5. Check proper condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



Checking charge-air coolant level by means of level sensor:

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 90).

TIM-ID: 0000000042 - 007

6.13.3 Charge-air coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 92).
2. Fill with charge-air coolant (→ Page 90).

TIM-ID: 0000000041 - 011

6.13.4 Charge-air coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

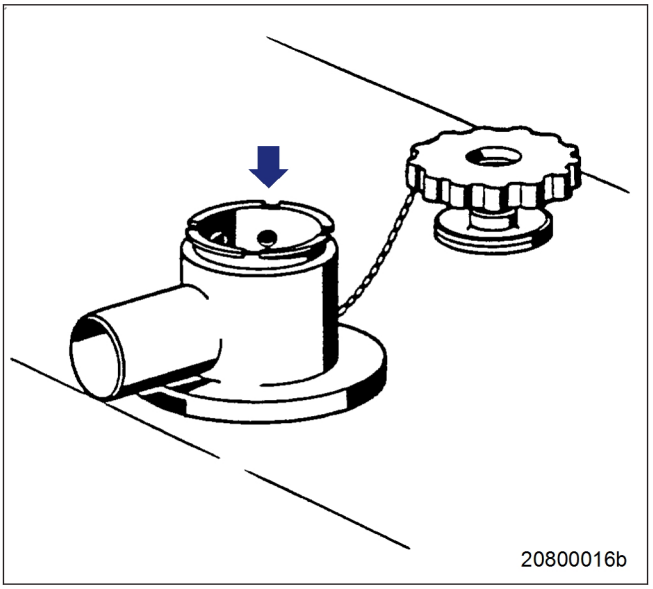
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

CAUTION

Cold coolant in hot engine can cause thermal stress.
Formation of cracks in components!
- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Remove plug screw from filling point on coolant line to intercooler.



TIM-ID: 0000000039 - 003

Charge-air coolant – Filling

1. Fill treated coolant through filling line or through filler neck of coolant expansion tank until coolant level reaches marking plate.
2. Install plug screws of filling points with new sealing rings.
3. Check proper condition of breather valve, clean sealing faces if required.
4. Fit breather valve and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 88).

TIM-ID: 0000000039 - 003

6.13.5 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

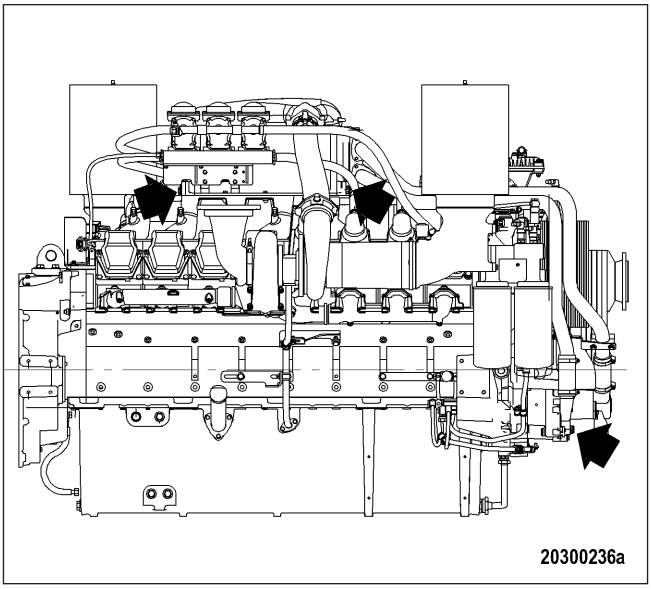
Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counter-clockwise and remove.
4. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
5. Open drain plugs and drain coolant at the following points:
   - At the charge-air coolant pump;
   - At the intercooler, engine driving end and free end sides.
6. Screw in drain plugs with new sealing rings.
7. Place breather valve on filler neck and close.



TIM-ID: 0000000040 - 002

6.13.6 Charge-air coolant pump – Relief bore check

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

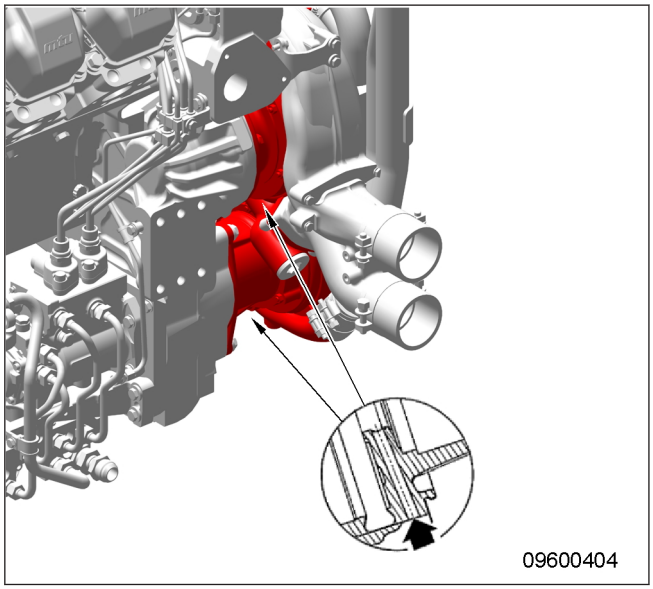
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Charge-air coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore is dirty:
   - Stop engine (→ Page 31) and disable engine start.
   - Clean relief bore with a wire.



TIM-ID: 0000025276 - 001

6.14 Belt Drive

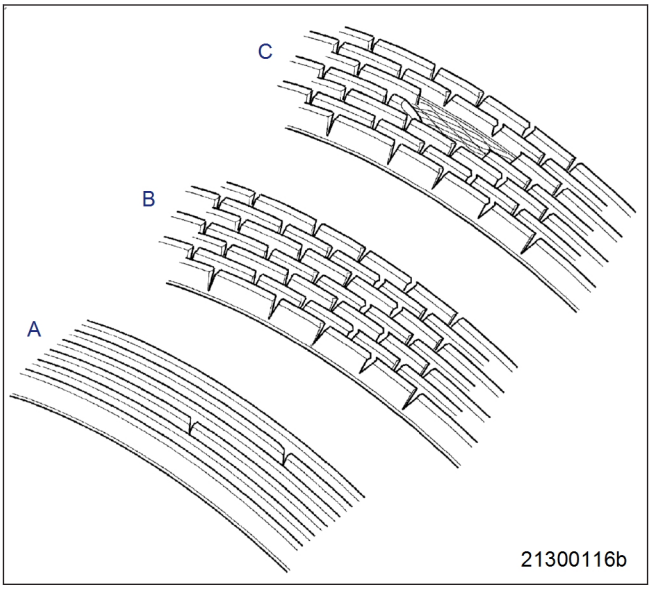
6.14.1 Drive belt – Condition check

Preconditions

☑ Engine is stopped and starting disabled.

☑ Guard is removed.

Drive belt – Condition check



Item	Findings	Action
Drive belt A	Singular cracks	None
Drive belt	Belt is oily, shows signs of overheating	Replace (→ Page 98)
Drive belt B	Cracks on entire circumference	
Drive belt C	Chunking	

TIM-ID: 0000000920 - 010

6.14.2 Drive belt – Tension check

Preconditions

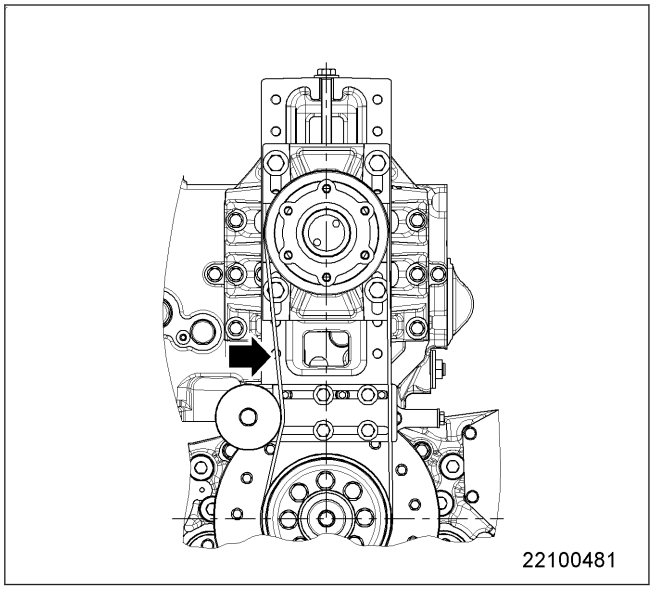
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Tester	Y4345711	1
Belt tension tester, 150-600 N	Y20097429	1

Fan drive – Checking belt tension

1. Remove protective cover.
2. Set belt tension tester onto the drive belt in the middle between the belt pulleys (arrow).
3. Using pushbutton, press vertically on top side of drive belt exerting even pressure until spring engages noticeably.
4. Do not press any further, otherwise the display value will be falsified.
5. Take off tension tester without changing the position of the display arm.
6. Read off measured value at the intersection of display arm and "KG" scale. For specifications, refer to table below.



Application	Specification Initial installation (new belt)	Specification Operating tension (used belt)
Fan drive belt	Frequency: 99 ±1 Hz	Frequency: 86 ±1 Hz

Table 2: Measuring belt tension with frequency meter

Application	Specification Initial installation (new belt, runtime 0.5-2 h)	Specification (used belt, runtime 500 h)
Fan drive belt	Depression depth: 5.6 mm Test force: 188 N	Depression depth: 7.2 mm Test force: 188 N

Table 3: Measuring depression depth with tension tester

Application	Specification Initial installation (new belt, runtime 0.5-2 h)	Specification (used belt, runtime 500 h)
Fan drive belt	Static tension: 4000 N	Static tension: 3000 N

Table 4: Measuring static belt tension

7. If the measured values deviate from the specifications above, adjust drive belt tension (→ Page 96).
8. Install protective cover.

TIM-ID: 0000025518 - 002

6.14.3 Drive belt – Tension adjustment

Preconditions

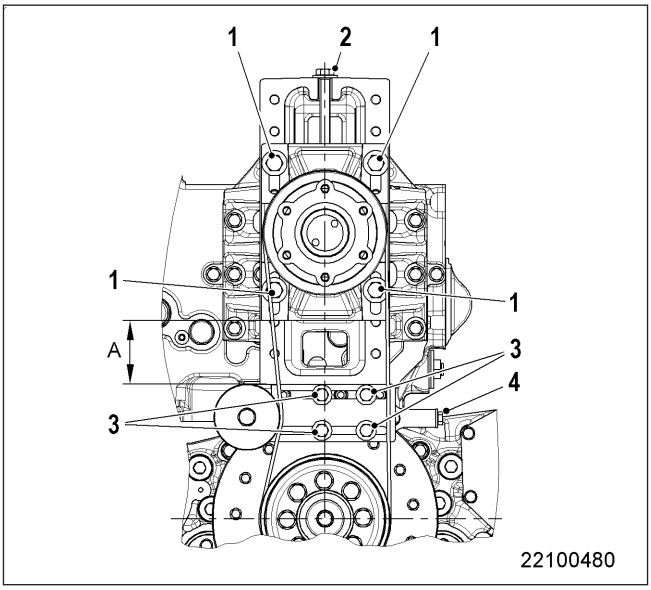
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter ½"	F30027340	1
Torque wrench, 40-200 Nm	F30027337	1
Engine oil		

Drive belt – Tension adjustment

1. Undo screws (1).
2. Set distance (A) to 100 mm with screw (2).



3. Use torque wrench (1) to tighten screws to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16x50	Tightening torque	(Engine oil)	180 Nm +18 Nm

4. Tighten screw (2) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16x280	Tightening torque	(Engine oil)	70 Nm +7 Nm

5. Undo screws (3).
6. Adjust belt tension with screw (4) (→ Page 95).
7. Use torque wrench to tighten screws (3) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Tightening torque	(Engine oil)	74 Nm +7 Nm

8. Use torque wrench to tighten screw (4) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12x240	Tightening torque	(Engine oil)	30 Nm +3 Nm

TIM-ID: 0000025520 - 001

6.14.4 Drive belt – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

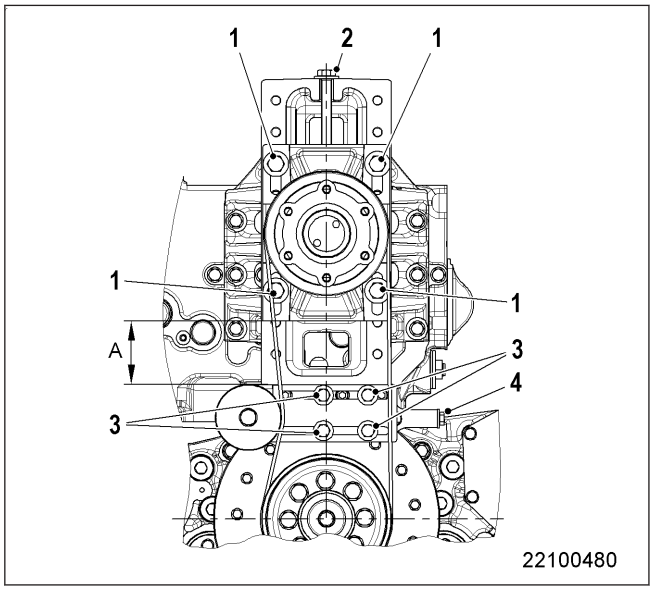
Designation / Use	Part No.	Qty.
Drive belt	(→ Spare Parts Catalog)	

Fan drive – Drive belt replacement

1. Remove protective cover from radiator.
2. Remove fan.
3. Slacken off securing screws (1).
4. Screw out screw (2) as far as necessary to allow drive belt removal.
5. Check belt pulley on radiator bearing mount and crankshaft for contamination and clean if necessary.

Note: When placing the drive belt in the grooves, no force must be applied.

6. Fit new drive belt.
7. Screw in screw (2) until distance (A) is 100 mm.
8. Adjust and check drive belt tension (→ Page 96).
9. Install fan.
10. Install protective cover.



TIM-ID: 0000025462 - 001

6.15 Battery-Charging Generator

6.15.1 Battery-charging generator drive – Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Mandrel	8205892861/08	1

Preparatory steps

1. Remove safety equipment (if fitted).
2. Remove screws of protective cover (engine free end).
3. Remove protective cover.

Drive belt – Replacement

1. Hold adjusting lever at square.
2. Rotate adjusting lever until drive belt is released.
3. Use mandrel to lock adjusting lever in position.
4. Remove drive belt.
5. Check cleanness of belt pulleys.
6. Fit new drive belt.
7. Remove mandrel.

Final steps

1. Install protective cover.
2. Install screws of protective cover.
3. Install safety equipment (if fitted).
4. Check function of safety equipment (if fitted).

TIM-ID: 0000007424 - 003

6.16 Fuel Supply System

6.16.1 Water drain valve – Check

Water drain valve – Check

1. Open water drain valve.
2. Check water outlet for obstructions.
3. Close water drain valve.

TIM-ID: 0000007733 - 007

6.16.2 Differential pressure gauge – Check

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Differential pressure gauge – Check

1. Switch on fuel treatment system (→ Page 26).
2. Set the alarm points at the differential pressure gauge to zero.

Result: Alarm is initiated with preset delay.

3. Reset the alarm points at the differential pressure gauge to the specified values.

TIM-ID: 0000023563 - 001

6.16.3 Water level probe (3-in-1 rod electrode) – Check

Preconditions

☑ System is put out of service and emptied.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Water level probe (3-in-1 rod electrode) – Check

1. Disconnect plug from water level probe.
2. Unscrew water level probe.
3. Disconnect plug from water level probe.
4. Immerse water level probe into a tank filled with water until water level reaches the thread.

Result: Water drain valve opens.

5. Leave water level probe in tank.

Result: Alarm must be triggered with the preset delay.

6. Disconnect plug from water level probe.
7. Remove water level probe from tank.
8. Screw in water level probe.
9. Connect plug for water level probe.
10. Put the fuel treatment system into operation.

TIM-ID: 0000023558 - 001

6.16.4 Pump capacity – Check

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Pump capacity – Check

1. Install suitable pressure gauge in the intake connection of the pump.
2. Check pump pressure.
   a) Switch on fuel treatment system (→ Page 29).

Note: The pressure limiting valve at the pump might respond and open. Audible noise is caused by overflowing fuel and can be disregarded.

   b) Close ball valve at the outlet of the fuel treatment system.
   c) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note down.
3. Checking pump pressure with reduced suction
   a) Reduce suction pressure of pump to -0.8 bar with the shut-off valve at the pump intake side.
   b) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note down.
   c) Open ball valve at inlet and outlet of fuel treatment system.
4. Calculate wear limit.

Example:	
Measured value (normal condition).	3 bar
Measured value (reduced suction condition).	2.6 bar
If the measured value (reduced suction condition) is 10% lower than the measured value (normal condition), the wear limit is reached. Repair pump (contact Service).	

TIM-ID: 0000023567 - 001

6.16.5 Coalescer filter element – Replacement

Preconditions

☑ System is switched off and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet adapter	F30027339	1
Diesel fuel		
Engine oil		
Coalescer filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

CAUTION

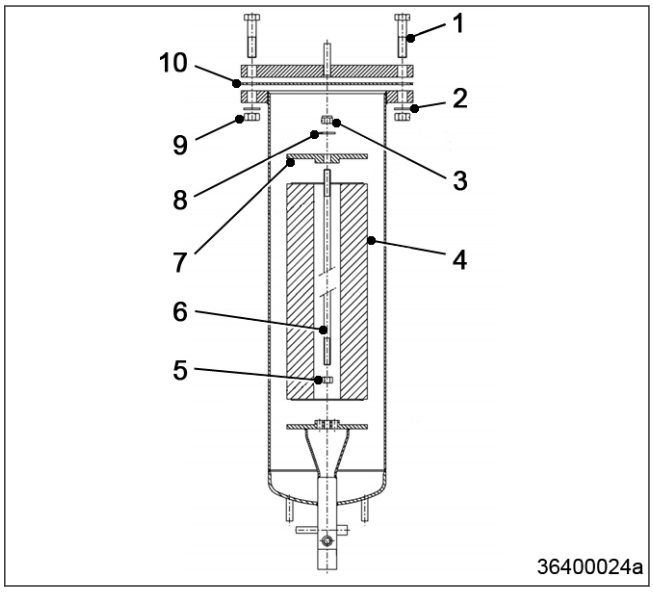
Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanness.

CAUTION

Incorrect installation of components and lines.
Damage to component!
- Ensure that components/lines are installed so that they are never under tension or strain.
- Ensure correct installation position of components.

Coalescer filter element – Replacement

1. Close ball valve at the inlet and outlet of the fuel treatment system.
2. Open drain valve.
3. Drain fuel.
4. Close drain valve.
5. Remove nut (9) with washer (2).
6. Remove screws (1).
7. Remove cover with gasket (10).
8. Remove nut (3), washer (8) and end plate (7).
9. Remove coalescer filter element (4).
10. Catch fuel as it runs out.
11. Clean housing with a non-linting cloth, rinse with fuel if required.
12. Check housing for corrosion.
13. Clean housing sealing surfaces.
14. Install coalescer filter element.
15. Install end plate (7), washer (8) and nut (3).



TIM-ID: 0000007735 - 007

16. Tighten nut (3) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut	M16	Tightening torque	(Engine oil)	30 Nm +3 Nm

17. Fit gasket (10).
18. Install cover.
19. Install screw (1), washer (2) and nut (9).
20. Tighten nut (9).
21. Open ball valve at the inlet and outlet of the fuel treatment system.

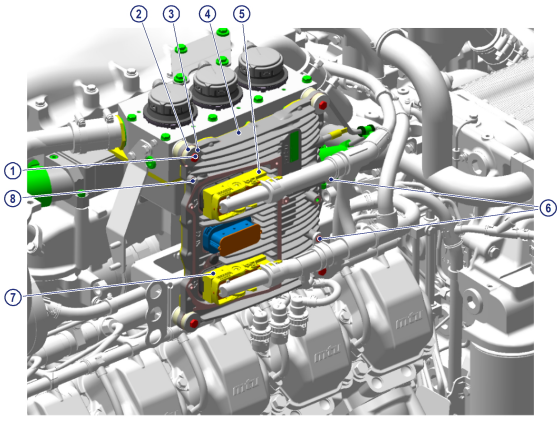
Result: The fuel treatment system is ready for operation.

TIM-ID: 0000007735 - 007

6.17 Engine Governor

6.17.1 Engine governor – Overview

1 Screw
2 Washer
3 Damper
4 Engine governor
5 Connector X3
6 Screw
7 Connector X1
8 Screw for grounding strap



TIM-ID: 0000031588 - 001

6.17.2 Engine governor – Removal

Preconditions

☑ Engine is stopped and starting disabled.

Preparatory steps

1. Observe safety instructions.
2. Switch off operating voltage.
3. Note or mark assignment of cables and plugs.

Engine governor – Removal

▶ Remove engine governor as per overview drawing (→ Page 105).

TIM-ID: 0000031586 - 001

6.17.3 Engine governor – Installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		
Damper	(→ Spare Parts Catalog)	8

Engine governor – Installation

1. Install engine governor as per overview drawing (→ Page 105).

Name	Size	Type	Lubricant	Value/Standard
Screw for grounding strap	M6x12	Tightening torque	(Engine oil)	Max. 8 Nm

2. Fit connector X1 and X3 on Engine Control Unit and engage locks.
3. Fit retainers for engine wiring.

Final step

▶ Enable engine start.

TIM-ID: 0000031642 - 001

6.17.4 Engine governor – Checking plug-in connections

Preconditions

☑ Engine is stopped and starting disabled.

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose.Otherwise the contacts could be bent.

Checking plug-in connections on engine governor

1. Check all plug-in connections for secure seating.
2. Latch connectors if loose.

TIM-ID: 000000048 - 005

6.18 Wiring (General) for Engine/Gearbox/Unit

6.18.1 Engine wiring – Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Engine wiring – Check

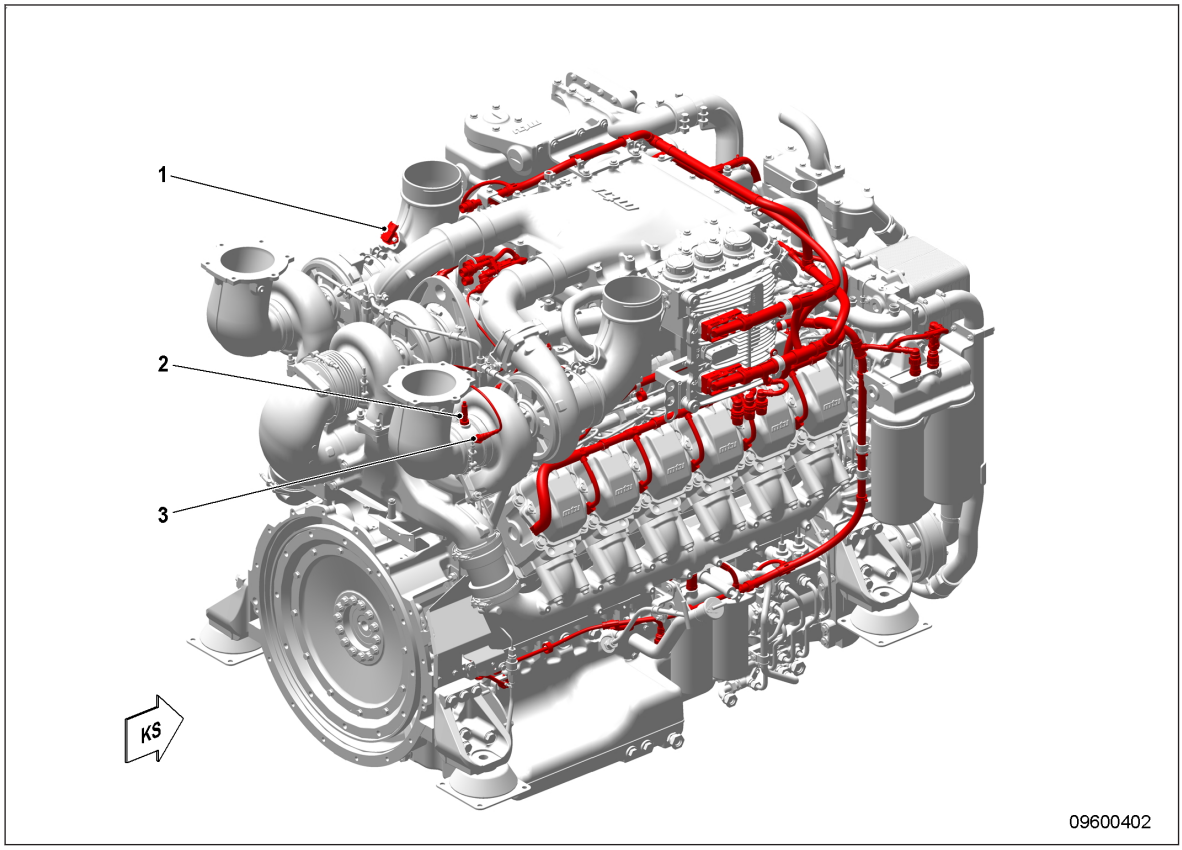
1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable ties are firm, tighten loose cable ties.
4. Replace faulty cable ties.
5. Visually inspect the following electrical line components for damage:
   - connector housings;
   - contacts;
   - sockets;
   - cables and terminals;
   - plug-in contacts.
6. (→ Contact Service) if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

7. Clean dirty connector housings, sockets and contacts with isopropyl alcohol.
8. Ensure that all sensor connectors are securely engaged.

TIM-ID: 0000000029 - 018

6.18.2 Lambda, NOx and humidity sensors – Overview



1 Humidity sensor 2 NOx sensor 3 Lambda sensor

TIM-ID: 0000025179 - 001

6.18.3 Lambda sensor – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Preparatory steps have been completed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Ratchet adapter ½"	F30027340	1
Lambda sensor	1	

WARNING

Component is hot.
Risk of burning!
- Wear protective gloves.

CAUTION

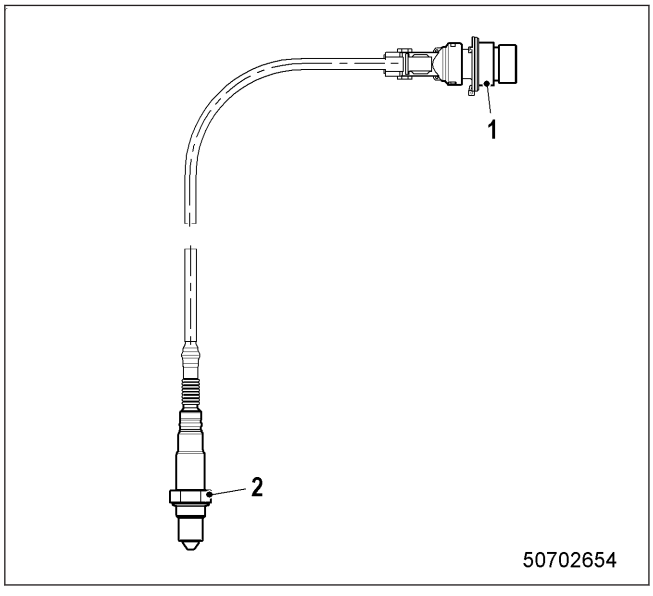
Overvoltage.
Damage to component!
- Switch off ignition voltage before exchanging component(s).

CAUTION

Fracture of ceramic cell due to shock load or impact.
Damage to component!
- Avoid shock load and impact.
- Handle sensors with extreme care.

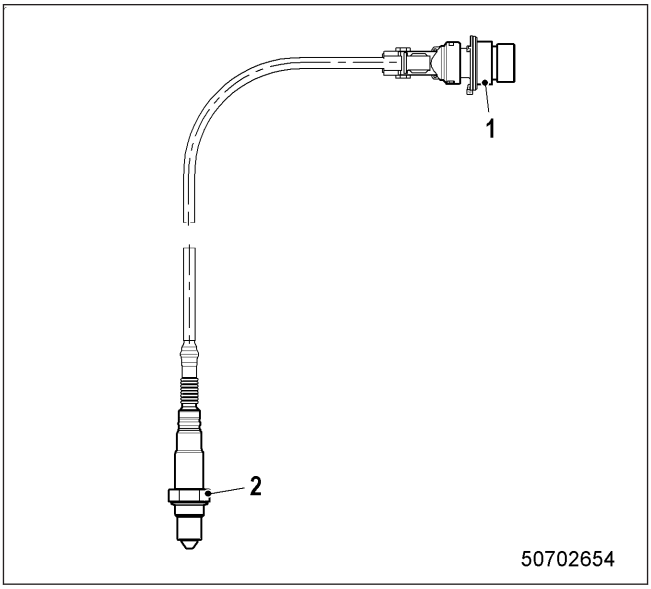
Removing lambda sensor

1. Observe the following general information:
   - Arrangement and position of sensor (→ Page 110).
2. Unplug and remove male connector (1).
3. Remove sensor via nut (2).



TIM-ID: 0000025194 - 002

Installing lambda sensor



Note: The sensor is considered defective after being exposed to shock load or impact and must not be used.

1. Remove the protective cap from the thread immediately before installation.

Note: Do not wipe off the grease the manufacturer applied on the thread.

2. Manually screw sensor into bore.
3. Tighten nut (2) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Sensor	M18 x 1.5	Tightening torque		40 Nm to 60 Nm

4. Fit male connector (1) and latch.

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

5. Reset CDC parameters (→ Page 117).

TIM-ID: 0000025194 - 002

6.18.4 NOx sensor – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Preparatory steps have been completed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Ratchet adapter ½"	F30027340	1
NOx sensor	1	

WARNING

Component is hot.
Risk of burning!
- Wear protective gloves.

CAUTION

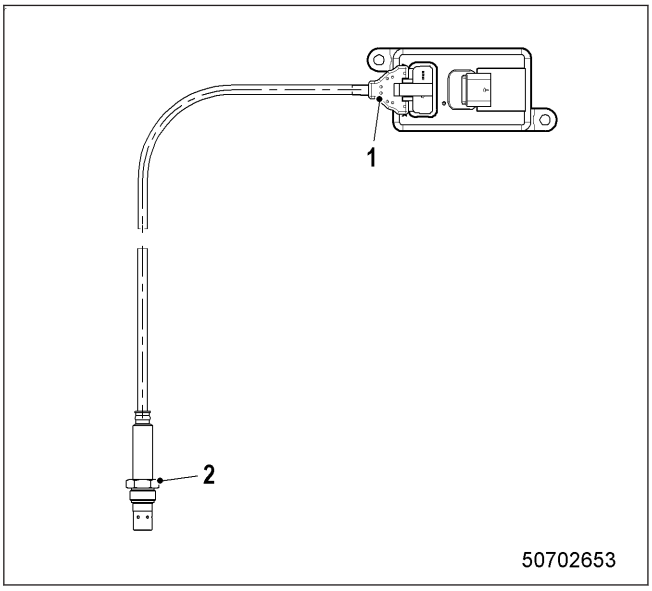
Overvoltage.
Damage to component!
- Switch off ignition voltage before exchanging component(s).

CAUTION

Fracture of ceramic cell due to shock load or impact.
Damage to component!
- Avoid shock load and impact.
- Handle sensors with extreme care.

Removing NOx sensor

1. Observe the following general information:
   - Arrangement and position of sensor (→ Page 110).
2. Unplug and remove male connector (1).
3. Remove sensor via nut (2).



TIM-ID: 0000025205 - 002

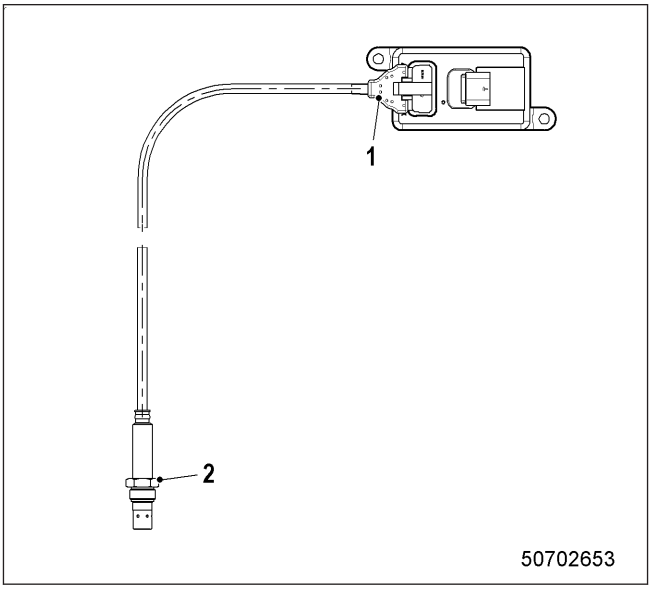
Installing NOx sensor

Note: The sensor is considered defective after being exposed to shock load or impact and must not be used.

1. Remove the protective cap from the thread immediately before installation.

Note: Do not wipe off the grease the manufacturer applied on the thread.

2. Manually screw sensor into bore.



3. Tighten nut (2) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Sensor	M20 x 1.5	Tightening torque		50 Nm ±10 Nm

4. Fit male connector (1) and latch.

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

5. Reset CDC parameters (→ Page 117).

TIM-ID: 0000025205 - 002

6.18.5 Humidity sensor – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Preliminary steps are completed.

Special tools, Material, Spare parts

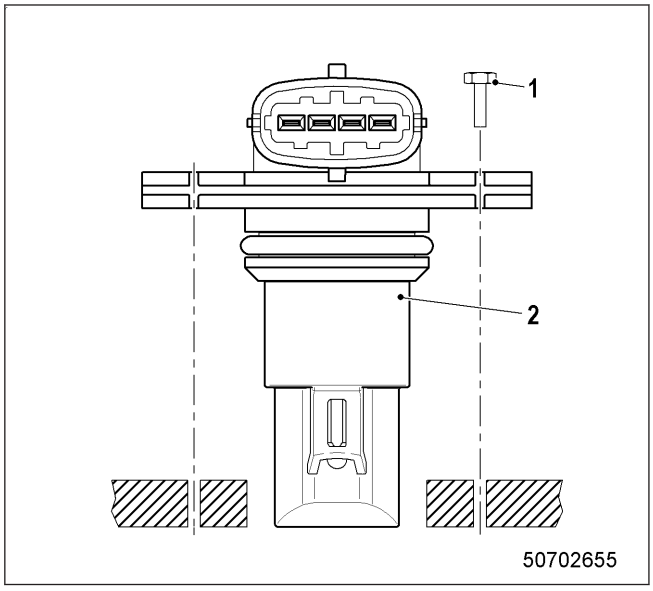
Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Ratchet adapter ½"	F30027340	1
Engine		1
NOx sensor	1	

CAUTION

Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanness.

NOx sensor – Removal

1. Observe the following general information:
   - Layout and position of sensor (→ Page 110).
2. Unplug and remove male connector.
3. Remove screws (1).
4. Remove sensor (2).



TIM-ID: 0000025206 - 001

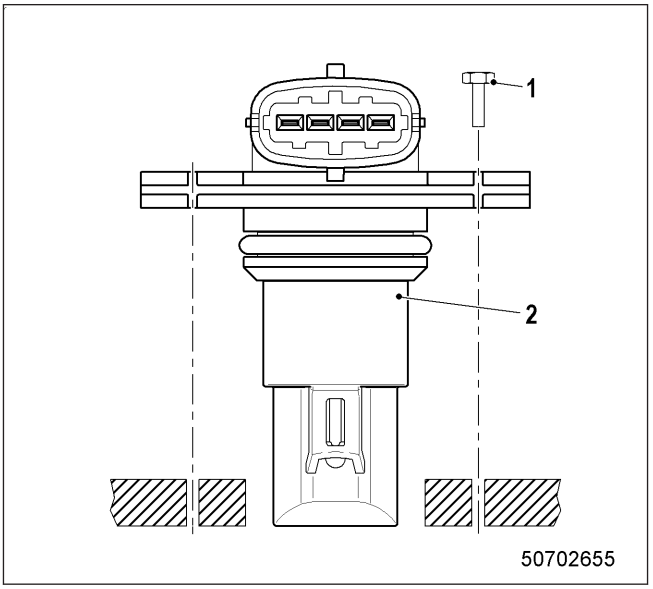
Humidity sensor – Installation

Note: Apply lubricant for O-ring sparingly.

1. Insert sensor (2) in bore, ensuring correct installation position.

Note: Take direction of air flow into account.

2. Screw in screws (1).



3. Use torque wrench to tighten screws (1) to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Sensor	M6	Tightening torque		12 Nm +5 Nm

4. Fit male connector and latch.

TIM-ID: 0000025206 - 001

6.19 Accessories for (Electronic) Engine Governor / Control System

6.19.1 CDC parameters – Reset with DiaSys®

Preconditions

☑ Engine is stopped and starting disabled.

Resetting CDC parameters (DiaSys® is available)

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

▶ Reset the CDC parameters with DiaSys® (→ Manufacturer's documentation).

Resetting CDC parameters (DiaSys® is not available)

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

▶ Contact Service.

TIM-ID: 0000029731 - 002

6.19.2 Engine governor and connectors – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose.Otherwise the contacts could be bent.

Engine governor and connectors – Cleaning

1. Remove coarse dirt from housing surface with isopropyl alcohol.
2. Remove dirt from connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

Cleaning severely contaminated connectors on the engine governor

Note: Seal unused connectors with the supplied protective cap.

1. Release the latch and pull off connectors.
2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and lock them.

TIM-ID: 000000047 - 009

6.19.3 Engine governor – Checking plug-in connections

Preconditions

☑ Engine is stopped and starting disabled.

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose.Otherwise the contacts could be bent.

Checking plug-in connections on engine governor

1. Check all plug-in connections for secure seating.
2. Latch connectors if loose.

TIM-ID: 0000000048 - 005

7 Appendix A

7.1 List of abbreviations

Abbreviation	Meaning	Explanation
ADEC	Advanced Diesel Engine Controller	Engine management system
AL	Alarm	General alarm
ANSI	American National Standards Institute	Umbrella organization administering and coordinating U.S. standards
ATL	Abgasturbolader	Exhaust turbocharger (ETC)
BDM	Backup Data Module	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	MTU Fluids and Lubricants Specifications, Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CPP	Controllable Pitch Propeller	
CR	Common Rail	
DIN	Deutsches Institut für Normung e. V.	German Standardization Organization, at the same time identifier of German standards ("Deutsche Industrie-Norm")
DIS	Display Unit	Display panel
DL	Default Lost	Alarm: CAN bus missing
DPF	Diesel Particulate Filter	
ECS	Engine Control System	
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data
EGR	Exhaust Gas Recirculation	
EIL	Engine Ident Label	
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare Parts Catalog (SPC)
FPP	Fixed Pitch Propeller	
GCU	Gear Control Unit	
GMU	Gear Monitoring Unit	
HI	High	Alarm: Measured value exceeds 1st maximum limit value
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HT	High Temperature	
ICFN	ISO – Continuous rating – Fuel stop power – Net	Power specification in accordance with DIN-ISO 3046-7
IDM	Interface Data Module	Memory module for interface data

TIM-ID: 0000002045 - 013

Abbreviation	Meaning	Explanation
IMO	International Maritime Organization	
ISO	International Organization for Standardization	International umbrella organization of all standards institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LCD	Liquid Crystal Display, Liquid Crystal Device	
LCU	Local Control Unit	LOP subassembly
LED	Light Emitting Diode	
LMU	Local Monitoring Unit	LOP subassembly
LO	Low	Alarm: Measured value below 1st minimum limit value
LOLO	Low Low	Alarm: Measured value below 2nd minimum limit value
LOP	Local Operating Panel	Control console, control panel
LOS	Local Operating Station	
MCS	Monitoring and Control System	
MG	Message	
MPU	Microprocessor Unit, Microprocessing Unit	
OT	Oberer Totpunkt	Top dead center (TDC)
P-xyz	Pressure-xyz	Pressure measuring point xyz
PAN	Panel	Control panel
PAU	Power Automation Unit	Module for monitoring, control and plant-related system integration of peripheral components
PCU	Propeller Control Unit	
PIM	Peripheral Interface Module	
PLD	Pumpe Leitung Düse	Pump-line-nozzle (injection system)
POM	Power Output Module	Module to control starter and battery-charging generator
RCS	Remote Control System	
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	US standardization organization
SD	Sensor Defect	Alarm: Defective sensor
SDAF	Shut Down Air Flaps	Emergency-air shutoff flap(s)
SS	Safety System	Safety system alarm
SSK	Schnellschlussklappe(n)	Emergency-air shutoff flap(s)
T-xyz	Temperature-xyz	Temperature measuring point xyz
TD	Transmitter Deviation	Alarm: Deviation in transmitter values
UT	Unterer Totpunkt	Bottom dead center (BDC)
VS	Voith Schneider	Voith-Schneider drive

TIM-ID: 0000002045 - 013

Abbrevia-tion	Meaning	Explanation
WJ	Water Jet	Water jet drive
WZK	Werkzeugkatalog	Tool Catalog (TC)

TIM-ID: 0000002045 - 013

7.2 MTU contact persons/service partners

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

Local support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: http://www.mtu-online.com

24h hotline

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you – either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact at Headquarters: Service-support@mtu-online.com

Spare parts service

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

Phone: +49 7541 908555

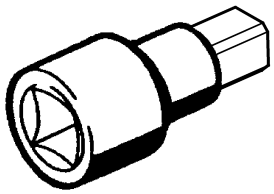
Fax: +49 7541 908121

TIM-ID: 0000000873 - 014

8 Appendix B

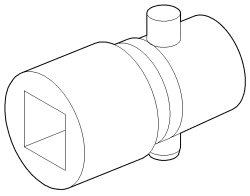
8.1 Special Tools

Adapter



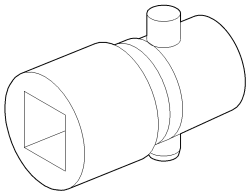
Part No.:	F30006234
Qty.: Used in:	1 6.4.2 Injector – Removal and installation (→ Page 49)
Qty.: Used in:	1 6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

Barring device



Part No.:	F6783914
Qty.: Used in:	1 6.3.1 Valve clearance – Check and adjustment (→ Page 44)

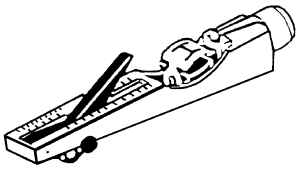
Barring tool



Part No.:	F6783914
Qty.: Used in:	1 6.1.1 Engine – Barring manually (→ Page 41)

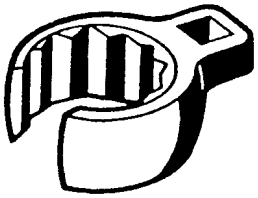
DCL-ID: 0000007590 - 003

Belt tension tester, 150-600 N



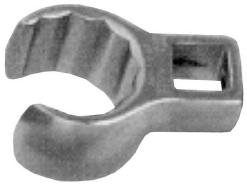
Part No.:	Y20097429
Qty.:	1
Used in:	6.14.2 Drive belt – Tension check (→ Page 95)

Crowfoot wrench, 19 mm



Part No.:	F30027424
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)
Qty.:	1
Used in:	6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

Crowfoot wrench, 22 mm



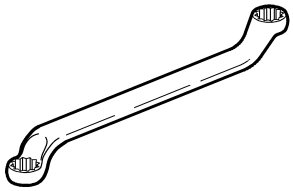
Part No.:	F30027425
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)
Qty.:	1
Used in:	6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

Double box wrench

Part No.:	F30011450
Qty.:	1
Used in:	6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

DCL-ID: 0000007590 - 003

Double-head box wrench

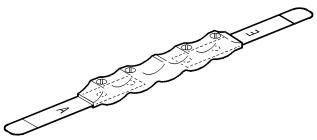


Part No.:	F30002800
Qty.:	1
Used in:	6.3.1 Valve clearance – Check and adjustment (→ Page 44)

Double-head box wrench

Part No.:	F30011450
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

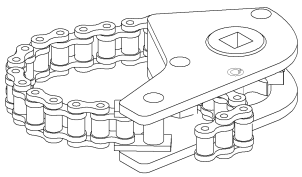
Feeler gauge



Y4_345893

Part No.:	Y4345893
Qty.:	1
Used in:	6.3.1 Valve clearance – Check and adjustment (→ Page 44)

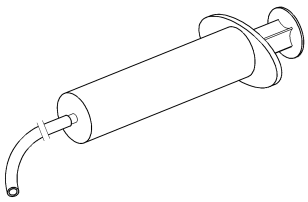
Filter wrench



Part No.:	F30379104
Qty.:	1
Used in:	6.6.1 Fuel filter – Replacement (→ Page 58)
Qty.:	1
Used in:	6.11.1 Engine oil filter – Replacement (→ Page 71)

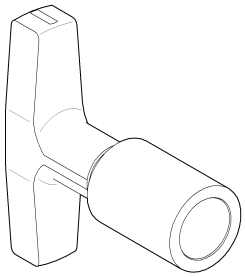
DCL-ID: 0000007590 - 003

Fuel suction device



Part No.:	F30378207
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

Installation device



Part No.:	F6790085
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

Mandrel

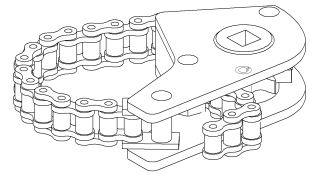
Part No.:	8205892861/08
Qty.:	1
Used in:	6.15.1 Battery-charging generator drive – Drive belt replacement (→ Page 98)

MTU test kit

Part No.:	5605892099/00
Qty.:	1
Used in:	6.12.7 Engine coolant – Sample extraction and analysis (→ Page 85)

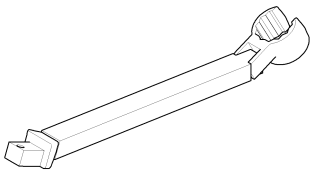
DCL-ID: 0000007590 - 003

Oil filter wrench



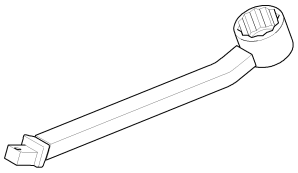
Part No.:	F30379104
Qty.:	1
Used in:	6.12.8 Coolant filter – Replacement (→ Page 86)

Open-end socket wrench, 19 mm



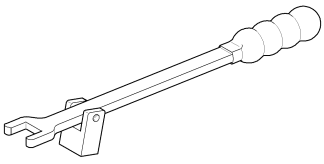
Part No.:	F30453236
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

Open-end socket wrench, 24 mm



Part No.:	F30453238
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

Puller

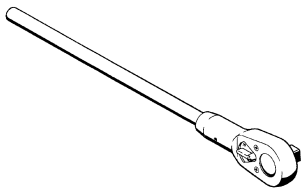


F6790636

Part No.:	F6790636
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

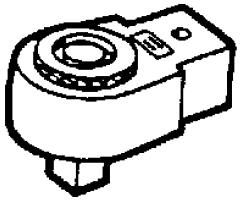
DCL-ID: 0000007590 - 003

Ratchet



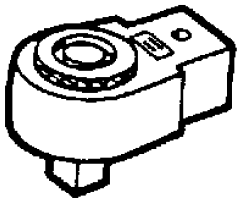
Part No.:	F30006212
Qty.: Used in:	1 6.1.1 Engine – Barring manually (→ Page 41)
Qty.: Used in:	1 6.3.1 Valve clearance – Check and adjustment (→ Page 44)

Ratchet



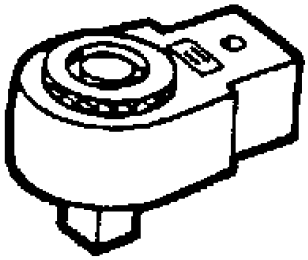
Part No.:	F30027340
Qty.: Used in:	1 6.3.2 Cylinder head cover – Removal and installation (→ Page 47)
Qty.: Used in:	1 6.4.2 Injector – Removal and installation (→ Page 49)

Ratchet adapter



Part No.:	F30027340
Qty.: Used in:	1 6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

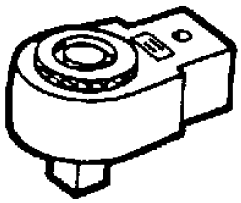
Ratchet adapter



Part No.:	F30027339
Qty.: Used in:	1 6.16.5 Coalescer filter element – Replacement (→ Page 103)

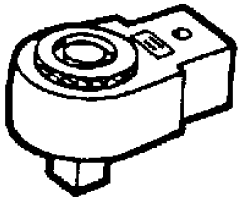
DCL-ID: 0000007590 - 003

Ratchet adapter ½"



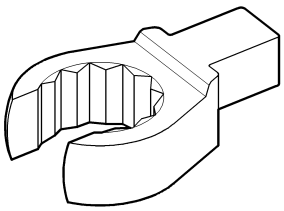
Part No.:	F30027340
Qty.: Used in:	1 6.14.3 Drive belt – Tension adjustment (→ Page 96)

Ratchet adapter ½"



Part No.:	F30027340
Qty.: Used in:	1 6.18.3 Lambda sensor – Replacement (→ Page 111)
Qty.: Used in:	1 6.18.4 NOx sensor – Replacement (→ Page 113)
Qty.: Used in:	1 6.18.5 Humidity sensor – Replacement (→ Page 115)

Ring socket, 19 mm



Part No.:	F30038493
Qty.: Used in:	1 6.3.1 Valve clearance – Check and adjustment (→ Page 44)

Socket wrench, 19 mm

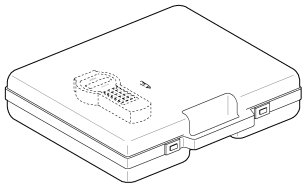
Part No.:	F30025897
Qty.: Used in:	1 6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

DCL-ID: 0000007590 - 003

Steam jet cleaner

Part No.:	-
Qty.:	1
Used in:	3.13 Plant cleaning (→ Page 35)

Tester



Part No.:	Y4345711
Qty.:	1
Used in:	6.14.2 Drive belt – Tension check (→ Page 95)

Torque wrench, 0.5-5 Nm

Part No.:	0015384230
Qty.:	1
Used in:	6.4.2 Injector – Removal and installation (→ Page 49)

Torque wrench, 10-60 Nm

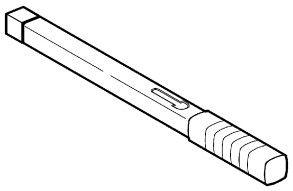
Part No.:	F30510423
Qty.:	1
Used in:	6.3.1 Valve clearance – Check and adjustment (→ Page 44)

DCL-ID: 0000007590 - 003

Torque wrench, 10-60 Nm

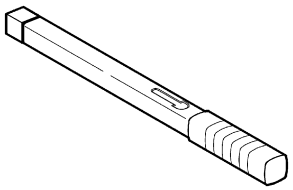
Part No.:	F30510423
Qty.: Used in:	1 6.18.3 Lambda sensor – Replacement (→ Page 111)
Qty.: Used in:	1 6.18.4 NOx sensor – Replacement (→ Page 113)
Qty.: Used in:	1 6.18.5 Humidity sensor – Replacement (→ Page 115)

Torque wrench, 20-100 Nm



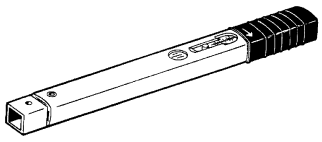
Part No.:	F30026582
Qty.: Used in:	1 6.4.2 Injector – Removal and installation (→ Page 49)
Qty.: Used in:	1 6.5.1 HP fuel line and pressure pipe neck – Replacement (→ Page 54)

Torque wrench, 20-100 Nm



Part No.:	F30026582
Qty.: Used in:	1 6.14.3 Drive belt – Tension adjustment (→ Page 96)

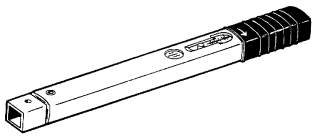
Torque wrench, 40-200 Nm



Part No.:	F30027337
Qty.: Used in:	1 6.14.3 Drive belt – Tension adjustment (→ Page 96)

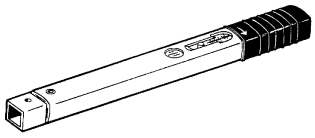
DCL-ID: 0000007590 - 003

Torque wrench, 6-50 Nm



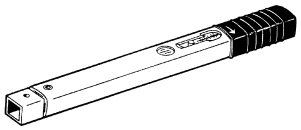
Part No.:	F30027336
Qty.:	1
Used in:	6.16.5 Coalescer filter element – Replacement (→ Page 103)

Torque wrench, 6-50 Nm



Part No.:	F30027336
Qty.:	1
Used in:	6.11.2 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 72)

Torque wrench, 8-40 Nm



Part No.:	F30043446
Qty.:	1
Used in:	6.3.2 Cylinder head cover – Removal and installation (→ Page 47)

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